CHAPTER 9

From Rebel Code to Alternative Paradigm: Free and Open Source Software, Innovations and Freedom to Operate

Introduction

In this chapter the idea of Free and Open Source Software (FOSS) is introduced in the context of software development and application and the various licenses associated with FOSS is examined in detail. The applicability of FOSS as an alternative model for IP rights is analyzed and FOSS is suggested as an alternative paradigm. The various business models based on FOSS are also discussed and their relevance to develop alternative business models is examined.

The expansion in the scope of IP rights and the grant of IPRs over research tools, genes, gene components has raised some questions about the enclosure of information commons and the implication for Freedom To Operate (FOT) in agricultural Research and Development (R&D). This is examined in great detail and the alternatives are also discussed. The idea that Open Source can be used over come some undesirable impacts of stronger IP rights is put forth in this chapter.

FOSS: Rebel Code and Beyond

Free and Open Source Software (FOSS) has emerged as an alternative paradigm for software development.1 FOSS is software that gives freedom to users and developers to modify and build on the code and distribute the derived software. The code is open- that it is available and can be modified and distributed as long as some conditions are met.

The FOSS thus enables collaborative software development, customization for different environments and needs, and testing by programmers in different contexts. Thus the end product is the outcome of involvement of many brains and hearts, working with a common objective. FOSS is based on the principle that source is free. Here free means freedom to run the program for any purpose, study its working, adapt it, redistribute copies, do improvements and share the improved one with others. Thus it gives freedom to use the software for the benefit of a community of users or a group. Here free need not mean that it is available at zero cost, as FOSS can be traded like any other product in the market. Here free need not be free as is in free lunch, but as in free speech, so goes the saying. The freedom to operate is more important here, unlike proprietary software which is covered by IPRs and end user license agreements.

Typical commercial software is protected by copyright or by patents or by both and comes with a right-to-use license. The buyer generally does not have any ownership rights over the software, and, so cannot do anything with that. A typical right-to-use license can restrict the user's right to use the software on no. of machines or number of installations, restrict the number of copies the user can make and normally the user cannot modify it or reproduce it, nor can the user distribute it.[2]

Further if the software has a built in encryption the user will not have the right to break that encryption, nor to write a program and apply this for this purpose. (compare with provisions of DMCA). Thus the rights of the end user are restricted and normally end user is charged for any upgraded version and for support also beyond the warranty period. The rationale for such a protection is similar to ones that are advanced for any other product or innovation. That IP protection is must to stimulate innovation, to reward the creators and to give incentives for investing in software development. The rationale for applying patents, copyrights, trade secrets apply here. The monopoly for a limited period will give incentives for developers and companies to come up with software needed by users and innovators can appropriate the rent. The objective of having a restrictive end use license is to ensure that 'illegal' copying in prohibited and there is a disincentive in terms of fines and legal proceedings to violate the conditions. As software can be copied and multiplied easily at almost no cost such a protection is justified on the ground that otherwise the pirated versions will outnumber the legally paid versions and the manufacturer will be deprived of the rents. Thus although often copy protection software is in built these conditions are also stipulated. For often software to break in the copy protection is also available. The user thus gets only a license to use the software under certain conditions.

The similarities between this end user agreements and agreements between farmers and manufacturers of seeds are striking. In both cases as the item is question can be reproduced easily or by its' nature can give copies of the same, use of IP is important to prevent 'unauthorized' usage. What is important is that, in case of software, the original source code is not made public. But in exceptional cases, when directed by court or as a part of anti trust measures software code may be shared with governments, as in the case of Microsoft. The idea of free software or sharing code among users is not new. It could be traced to the 1960s and 1970s where due to hardware incompatibility often programs had to be rewritten and run to be run on different systems. So among mainframe users in academia access to source code was a necessity and denying that was not an acceptable practice in the context of ethic of sharing and for practical purposes also it was a necessity. Another factor which facilitated this was the practice of AT&T's Bell Laboratories to give source code to others, so that the bugs in UNIX Operating System could be found and fixed. As a part of the deal on the monopoly status AT&T was barred from engaging in commercial computing activities. But UNIX source code was covered under copyright and even then it was distributed to users. The users had the option of trying with source code and modifying it. In the 1960s hardware vendors were the major producers of software and both were often bundled together. There was no independent software industry worth the name. But a anti-trust suit against IBM in 1969 was filed and IBM was made to sell software separately and soon IBM began to charge for the same time, apart from not, sharing the source code, insisted on a non-disclosure agreement for giving an executable copy. The late 1970s and the early 1980s saw the boom of the personal computers and with that the demand for software grew by leaps and bounds. The software industry capitalized on this demand and software became like any other commodity, could be sold, and, protected by IP. Thus software was no longer available for free or the source was available for sharing and modification by user. The Microsoft founded in 1975 developed the Operating System for IBM PC and its compatibles. It allowed manufacturers to ship the OS software with the system and software was protected by IP, i.e. copyright.

The Free Software movement was founded by Richard Stallman to promote 'free software', software that could be shared, modified, distributed and improved with access to source code. The Free Software Foundation was established to further free software. But free software need not be free, i.e. available at, zero cost. Copyright was seen as a method of creating unequal access and restricting the options of users. As a counter measure Free Software Foundation has developed a standard agreement – the GNU General Public License (GPL) also known as 'copyleft'. The GPL was developed with the objective of preventing the enclosure or conversion to proprietary mode or restricted copyrighted software, out of the open/free software source code. GPL does not permit users to add restrictions, to other users' right to test, copy, modify, and distribute the program.[3]

It can be concluded that that this represents a philosophical position on software under copyleft. Copyleft agreement is one of the options under FOSS. There are others like, the GNU Library General Public License, the Artistic License, and the Berkeley Software Design-style license. GPL represents a philosophy espoused by Stallman.[4.]

GPL has undergone revisions. Stallman also made some software available under GPL (e.g. Emacs text editor, the GCC Compiler and GDB Debugger). These were used mostly in UNIX environments. The BSD (Berkeley Software Distribution) version of Unix was offered under a license very similar to GNU License. But the crucial difference is derivative works need not be covered under the terms of the original license.[5] The Apache License, under which the Apache Server software is available is a license similar to the BSD License. Thus there can be many licenses which are similar but not identical.

This differentiates the Open Source License from that of GPL. In other words under Open Source License copyleft condition is not mandatory. When a programmer wants to use parts of a proprietary code with that of free software GPL is not of much use. Hence GPL is not suitable for all occasions. In reality the programmers or developers have to be pragmatic and practical as proprietary code could be technically better and to write an equivalent one and offer it as free software would amount to reinventing the wheel. Hence although GPL was a pioneering model there was a need for an alternative to that.

Open Source and Linux

Linux is the Operating System developed and made available under Open Source mode. The history of the development of Linux, started with the project undertaken by Linus Torvalds, details of which are too well known to be repeated here.[6]

The Linux is based on Open Source Model different from the Free Software Model advocated by Stallman. Open Source Initiative was founded in 1998. The Open Source Definition (OSD) prescribes the following:

1. Source code must be distributed with the software or should be made available at a cost, not exceeding the cost of distribution.
2. Software can be redistributed for free, without the need to pay Royalty or licensing fee to the author
3. Software can be modified or another software could be derived from that and the derived software can be made available under the same terms.

Thus Open Source Model is different from Free Software position. Under GPL redistribution of GPL software has to be done only under GPL. But with Open Source Model, the redistribution can be under the same terms, but not mandatory. For example a license under OSD can permit a developer to modify the software and release the modified version, under new terms. The new terms may even make it proprietary but as long as the OSD criteria are met it is considered as Open Source Software.

The clash between Open Source advocates and Free Software advocates is because of the ideological differences. Although there is a lot in common in both approaches the crucial difference is in the ideological underpinnings. While Free Software is based on lofty principles, including altruism and disdain for commercialization, Open Source is a pragmatic response which aims at providing reliable solutions to the corporate users and individuals, without becoming a monopolist. The Open Source philosophy thus tries to harness the spirit of cooperative software development and the idea of keeping the source open to develop high quality software that can meet the exacting demands and could be deployed in different types of systems, ranging from Personal Computers to Super Computers. While the initiatives under free software movement resulted in excellent products, their use was mostly confined to Unix community.

In contrast open source attracted the attention of many users, industry and trade. For reasons of space the details are not given here. Suffice is to say that many hardware manufacturers and companies like IBM have committed to Open Source principle. Similarly Sun Microsystems made available the code of Star Office and this resulted in Open Office, a product which offers what MS-Office offers but at a very low cost and with source available for free. The Open Source Model exemplified by Linux also emerged as a serious competitor to the OS offered by Microsoft- Windows and its versions. The details about the Linux vs. Microsoft are not of much relevance to this chapter and that is skipped in this chapter.

As Lancashire points out to a great extent the FOSS model was developed in the USA and major players are based in USA.[7] But FOSS is becoming a global phenomena because the potential of FOSS has been understood, particularly, its relevance for developing nations. Hence in countries like India, China and Brazil activities relating to FOSS have gathered momentum, especially in making available local versions of Linux in various languages, in developing Linux based devices etc. [8]

Although Free Software movement was the forerunner, it was perceived as an ideology propagated by committed developers and supporters who were unwilling to be flexible in their views. In contrast Open Source is a flexible approach that permits various types of licenses and, more importantly practices, that can be non-commercial, commercial or a hybrid. Thus Open Source can be viewed in many different ways, depending upon the function/approach/solution or idea one wants to put forth. This flexibility makes Open Source as an ideal paradigm that can be used in many different contexts.

1. Open Source as a contrast to closed source and strongly protected software : With the availability of source code, customization and further development, in contrast to code for commercial software which is not shared with the user and which is protected by IPRs like trade secret, patents.
2. Licensing Mechanism: The copyleft model uses copyright so that it is available without ending up as proprietary software. But if the same is placed in public domain misappropriation is possible and further rights can be claimed on the modifications and restrictions can be incorporated as a part of the end-user agreement or license. So as a licensing mechanism Open Source creates facilities for the user and developer.
3. A Software development process: In Open Source development software development is cont confined to a single organization or a small group. Often thousands of developers/programmers work in projects that demand various types of

skills and where best ideas emerge after much testing and debugging. Since the development process itself is a collective endeavor it has many advantages over a typical commercial development process which is done in a single company or in a formal alliance, often with limits/ restrictions on disclosure of source outside the company or alliance. As a theory and praxis Open Source is an alternative mode of organizing and production.

4. Open Source as 'Gift Economy': This feature of Open Source is possible because of shared values and a communitarian spirit. Professionalism, reciprocity, altruism and commitment to collective good matter here. Thus the non-economic factors and values are important in fostering and maintaining a communitarian spirit. In contrast the commercial software development is based on a different model where organizational hierarchy, monetary factors and division of labor form the basic principles.

5. Mechanism of, recognizing good work, gaining reputation and honor in the peer community: This is similar to the ethos of the scientific community where peer review and recognition, professional recognition and honor are important in securing tenure, grants and fellowships and in advancing in the career. Here the non-monetary factors are crucial to decide the standing of the professional/scientist and the rewards are many. On the other hand the peers also expect to commit oneself to some ethos and conduct oneself according to the mores and good practices set by others. This picture of science is too ideal a picture and the real picture is more complex. Despite all the claims the scientists have also been accused of professional misconduct and failure to live up to the standards, not to speak, of the controversies over 'owning' scientific research or academic work.[9] In FOSS also there have been similar problems, particularly forking of projects or clash of egos. Thus there are many

parallels between the functioning of the scientific community and FOSS community. In contrast the commercial software industry is organized in terms of groups with deadlines, team leaders and project managers and the development and delivery models decide the deployment of resources – human and system.

6. Open Source as a movement Business models that are, hybrids of free software/open source/proprietary software models, in developing, selling and servicing of software. The Open Source model gives enough flexibility to create new business models as there are many types of licenses available to cater to specific contexts and the flexibility to combine different models is due to the fact that open source philosophy or idea, is open to many interpretations. In developing a hybrid model, a company can choose the features of open source that give a competitive edge and form basis of a sound strategy. Thus Open Source is a business philosophy as well. Because of this various companies like IBM, Sun Microsystems have extended support to Open Source models, in one way or other. An obvious question is, if Open Source can mean anything, how to differentiate Open Source Model from others. The answer is Open Source idea can be used to develop various models which combine the flexibility of the Open Source (e.g. giving source code with freedom to develop it further or customize it) with typical business delivery models.

In terms of IPRs FOSS gives an alternative option and these models do not restrict the rights of the users as the typical commercial end-user license does. Another advantage with FOSS is as the source is open and available the user is free to fine tune it or make appropriate changes. Moreover FOSS has demonstrated that commercially also the model can succeed in developing and delivering high quality software that can also be supported by various vendors. For hardware vendors also adopting this model helps them to bundle software available as FOSS with their products or use them to develop software that can be integrated in their products.[10]

Hence the FOSS model is emerging as an alternative to the dominant model of software development and delivery. The FOSS model also indicates that if properly handled IPRs can trigger further innovation without monopoly rights. The justification for IPRs, i.e. exclusive rights re a must for further innovation has been challenged by this model.

Open Source: An Alternative Paradigm

In software development, FOSS has emerged as an alternative mode chiefly because of the following:

1. In FOSS the number of developers involved in testing, debugging and fine tuning the software is high and this collaborative work has been facilitated by the internet. Since problems are tackled by many persons, often simultaneously, the possibility of a bug not undetected, or a better and compact code not being written are low. Thus quality is ensured and the review process is as good as a peer review process. The ethos of sharing and collaborating ensure that the software is of very good quality, with inputs and testing by many developers. As Eric Raymond puts it 'given enough eyeballs, all bugs are shallow'.
2. FOSS is not based on the logic of the market or the necessity to meet new products in time. The software under FOSS is always evolving and the software can be released as and when the updates and patches are ready. As the goal is not revenue maximization or maximizing license fees, the development and distribution are not hampered.
3. User gets software with less limitations and restrictions. It is true that both commercial software and software under FOSS model do come with some conditions, but software under FOSS gives the user more freedom and more

importantly the user is not bound by any condition on the number of installations or number of copies.

4. Availability of source code enables the user to modify it to suit the existing systems or to customize it. The user can use his/her own team of developers for this purpose. This gives the user many advantages in system integration, migration from one system to another, and fine tuning the software.

However this does not mean that FOSS process is always perfect or will deliver in time. Nor there is a guarantee that the developer teams will always act in unison. The projects initiated by FSF or Stallman have encountered many problems for one reason or another. Forking is another issue that can derail software development in FOSS. When the available development resources are divided between dissenting team and the main team the software development tends to get bogged down. Forking is the bane of the FOSS and even projects of FSF have been affected by it.[11] Another problem with FOSS is there is no guarantee that the projects will be finished in time or the users needs, will always be fulfilled. Still FOSS has emerged as an alternative model because it is based on a different model of working and organizing. The various studies on FOSS highlight the fact that in many aspects FOSS resembles gift economy and production of open science.[12] The institutional devices dealing with creativity vary among patents, Open Science and FOSS. In case of Open Science and FOSS incentives, and distribution devices reflect the ethos of the community where as in case of patents monopoly power is an important incentive.

One of the major questions has to do with the necessity of public involvement, for instance to secure public licenses by making sure that existing laws properly allow for the existence and sustainability of such licenses. As for now, the CopyLeft scheme has emerged as an alternative institution without any public intervention.[13] In FOSS development in decentralized and is facilitated by internet.[14]

Most of the developers are also users of the software and hence are able to figure out the needs of users and make changes accordingly. In contrast in the commercial software industry, users and developers are two different communities. Commercial software companies attend to the users needs in many ways, but usually the development and release of software is a time consuming process as it has to undergo beta tests. In contrast thanks to internet and decentralized mode of working feedbacks are almost instantaneous and whatever the bugs are, they are attended to. Thus the software is developed and perfected simultaneously. Involvement of a community facilitates exchange of ideas and suggestions and the collective efforts result in, software which is superior to commercially produced software in many cases. That is why some of the FOSS products are very popular.[15]

Another unique feature of FOSS is rate of diffusion is faster than commercial software and with no constraints on distribution and copying FOSS tends to get disseminated fast. In case of commercial software there are many factors which decide the diffusion. Hence even if there is a need for up gradation, unless sufficient volume is there to justify the investment the producer will not be willing to invest in developing an upgraded version. The faster diffusion helps the FOSS to compete with commercial software. Linux is a good example of this.

In their seminal work David and Dasgupta compare and contrast two distinct models of knowledge creation with different incentive structures.[16] In 'Science' peer recognition and the following reputation result in grants, positions, tenure with more benefits and recognition outside the academia. Thus the peer recognition is an incentive which is essential for a scientist. Peer recognition is based on the quality of the contribution, the newness of the knowledge and the significance of the work in terms of the scientific knowledge. Although peer recognition is a non-monetary reward, it could result in benefits, including monetary benefits. But the scientific community is organized on some principles as articulated by

Robert Merton and the Republic of Science rewards in its own ways. Peer evaluation is very important in science.

In contrast in 'Technology' the incentive structure is based on maximization of profits, secured by property rights. To achieve this knowledge has to be private or property rights will have to claimed and assigned. What is interesting in the findings of David and Gupta is that in the same research areas different types of incentives can exist simultaneously. The aspirations of the scientists matter and the incentive structure is important to attract and retain talent. A scientist who has made seminal contributions can expect greater rewards for his contribution as the peer recognition makes him/her more visible to others and the open nature of the publication and dissemination of work gives him/her wider reach than a technocrat who works of projects, the results of which may not be shared easily or is confined to the industry. Thus incentives need not be monetary and in science, the non-monetary recognition by peers could result in monetary and non-monetary benefits. Copyleft and copyright represent two modes of incentive structures.[17]

Software, Patents and IPRs

A developer can convert his/her program/source into an open source /free software or can protect it under an IPR. When the possibility of obtaining a copyright or a patent exists why, many developers opt for FOSS by giving up secured property rights? What is striking is that FOSS continues to survive and flourish even when stronger IPRs are available for computer programs and software. Initially computer programs were covered by copyright only, but later patent protection was made available to them. But patenting software has been controversial. It is not necessary that only copyright or patent should be used to protect computer software, trade secret can also be used.

The scope of patentability has undergone drastic changes over the few decades and in USA many patents on software have been issued, unlike Canada and EC.[18] In the USA in a significant decision in Diamond v. Diehr, the Supreme Court ruled that computer technology should be treated as any other technology under the patent laws and inventions involving computer programs can be subject matters for protection. There has been a phenomenal growth in the number of software patents since 1981 and the patent scope has also been discussed extensively.[19]

Under TRIPS patents on computer programs is permissible. According to Article 10(1) of TRIPS "computer programs, whether in source or object code, shall be protected as literary works." But a reading of the Article 27(1) shows that there is no bar on patents on computer programs/software. According to that Article "subject to the provisions of paragraphs 2 and 3, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application."

But this does not mean that all countries should grant patents on computer software. As the 'combined language' of Articles 9.2 and 10.1 give an impression that computer software is excludable from patenting per se, and by applying Article 1.1 and by resorting to their national practices patent protection for patents can be given.[20]

Thus whether computer software can be covered by copyrights or by patent is a controversial issue. It has been argued that software should not be patented as it can be defined as an 'idea, procedure, method of operation or an algorithm '. However both PTO and courts have recognized the patents on software and hence this argument is not of much value. Moreover if business methods could be patented, there should not be any bar on software patents. If business methods are processes as the Federal Circuit put it in State Street Bank & Trust Co Vs. Signature Financial Group Inc, computer software, which leads to production of goods and service, can also be classified as a process, and, hence patentable.

Over the years the nature and scope of IP rights in computer software has been examined in many cases.[21]

Thus in one sense FOSS is a paradox, as while the IPRs on computer software have become stronger over the past few decades, FOSS has emerged as a strong competitor to proprietary software in almost all segments. This only proves that strong IP protection is not always necessary to foster innovation or to succeed in the market. However the impact of software patents on FOSS is controversial. Obviously FOSS advocates have been highly critical of software patents.[22] At this juncture it is not clear as to whether using source code would amount to infringing a patent.[23]

The Peer Production Model and IPRs

Although FOSS has been proved to be a model for development of software, its significance lies in its use as a model and a paradigm to 'peer production of information' and beyond.[24] In deed as Benkler shows, apart from software this peer production of information has been used in many other fields, ranging from creating collaborative content to probing extra terrestrial life. What is the role of strong IPR in such efforts? According to Benkler strong IPRs are not necessary except in self-defense.[25]

This essay by Benkler points out that an alternative mode of organizing production of goods and services may be possible and this mode overcomes many problems associated with the traditional modes of production. Thus FOSS is a model that can be extended to other areas also. It has been tested in other issues also. Moglen asserts that proprietary culture is acting as a barrier that has to be resisted, and humans as social species create together.[26]

FOSS Models, Biodiversity and IPRs: An Exploratory Exercise

Can the models and licenses used in software development and distribution be used for finding solutions and to foster innovations in other areas also? As discussed elsewhere the FOSS model is emerging as a viable model in software and the studies on FOSS development have proved that FOSS provides a viable model. But it is obvious that software development has some unique features and FOSS could not have flourished but for the internet and the collaborative environment facilitated by internet. Moreover developers as a community are also users of software as well as creators, testers and reviewers and this need not be the case in other areas. In case of collaborative content creation (e.g. various initiatives based on Wiki, projects like Project Gutenberg) often there is no commercial motive or the volunteers participate because of interest and commitment to a common cause. These features need not be applicable to other areas where different ethos and norms may be in vogue. Moreover will a FOSS model be a viable model that can be transplanted elsewhere?

Although there is literature available on FOSS models in business, particularly in software and about models similar to or based on FOSS models in other areas, a problem with them is most of them are based on anecdotal evidence or reflect the views of pioneers of FOSS. There are not many detailed case studies which examine the FOSS models in other areas, and the theoretical literature of FOSS is growing, but a lot of questions remain unanswered. . In this chapter some of the issues that are relevant to developing FOSS Models for Biodiversity and Intellectual Property Rights are explored.

Both Microsoft and Monsanto, although, engaged in diverse businesses insist on an agreement to be accepted by the user and the agreement restricts the rights of the user apart from enforcing IP rights of the companies. In case of seeds Monsanto also charges a technology fees. For the companies this model has many merits. It helps them to enforce IP rights and charge different prices for different types of customers and more importantly through the licenses and agreements they create legally binding commitments from users. Microsoft thus can have different prices for different types of users, while also having a flexible policy for multi user institutions in terms of using software in many systems. It can also offer steep discounts with contracts/agreements to capture the market share without giving up IP rights.

On the other hand the costs of such transactions are many, the costs are high in the short term as the monopoly position would be used to the greatest advantage, in the absence of a competitor, as it had happened in case of Windows OS for PCs where Microsoft had a near monopoly position. The initial cost of development could be reaped many times over as the volume increases, resulting in huge profits. With user has to pay for updates the costs for any investment in up-gradation is also recovered from the user. In case of seeds the 'planned obsolence' ensures that the farmers return to the breeder or seed provider for 'new' varieties as the old varieties are no longer available. Mere commercial novelty is sufficient to make IP claims.

A FOSS solution/alternative to the above models will give more rights to the users, without restricting the rights of the initial developer, and, will use IP rights to prevent enclosure or creating stronger IP rights by others, that, restrict the rights of users/developers, downstream. Here the use of IP is not to not to extract rent, but to protect rights and to prevent misappropriation. Further this model will also ensure that the users need not get locked in to a particular product or planned obsolence is avoided and genuine innovations are preferred. The updates and upgradations will be dictated not by the profit maximizing objective but by the needs of the users and the demand for the same. In the absence of a monopoly, multiple players can cater to diverge needs of the users.

For example the needs of small farmers can be catered by a public sector institution while the needs of big farmers, or, needs of those producing primarily for market can be catered by seed producers. Irrespective of the users, FOSS model will have some common features.

In case of FOSS licenses the idea is to allow users to gain access to IP and encourage further development. The first developer or the pioneer thus need not do everything but can facilitate further development through an IP policy. The user is not a mere user, but a co-developer (and, in many cases tester) as well. But this cannot be possible unless they have access to the 'source' that they can build around. In case of software this is facilitated by access to source code and sharing of source code. But the incentive to contribute to a collaborative development can be provided by allowing the users to use the source code or the source material without many restrictions or by giving them the freedom to operate as in case of agricultural R&D. This can be done by using conditions that prohibit terms which will bar or severely restrict, the rights to use, distribution or redistribution or modification of the matter under license. Thus FOSS model can encourage further innovation without affecting the rights of the source provider or developers who built the source code initially.

At this juncture it can be pointed out the FOSS model will insist on a license that does not negate the ownership right of the source provide or the ownership rights over the source. Hence FOSS model is not a model that distributes source freely or make it available for one and all, with no condition. But the ownership rights are used to create many users or developers who have the incentive to build up, improve and innovate further. The absence of stronger IP rights does not mean that ownership rights are given up or exchanged in terms of licensing agreements. The subject matter need not be given to public domain, as free access, for all, nor, it need, to be privatized fully, with strong IP rights. Rather FOSS model will stimulate innovations without enclosing the source or genetic resource.

It will help in contributing to public domain without drawing from public domain for the purpose of enclosing or creating strong proprietary rights with IP rights that restrict others rights. An obvious question will be – does this amount to giving away intangible assets created through IP rights, to one and all, including competitors, through licenses. Or what is the need for the model if it could result in less profit than what the normal model would generate. The answer is, it is not so. Here the objective can be achieved without resulting in losses, if it is understood, that, the idea is to use the 'assets' in an way that is economically advantageous or a steady source of revenue can be created. The value of source code or a genetic resource, lies, not in it per se, but in using it to meet some objectives. If by allowing many users to have access to code and thereby create a revenue stream through licensing agreements, the developer can benefit more, than, by restricting access, what can be wrong with such a model. Here the IP rights are used to facilitate access and use, than to restrict them. In the process more income can be generated and more the number of users or licensees the source code or the resource will gain more, acceptance in market.

An analogy can be drawn in the case of Microsoft and Apple Computers. While Microsoft allowed various manufacturers to bundle the Operating System (first DOS, then various versions of Windows) with IBM compatible PCs under some conditions, Apple refused to do so. Rather it built the computer and shipped with the OS installed. Thus it restricted itself to a small segment of the market. On the other hand with Microsoft, as it had a significant share in the market, third party developers, could develop software for use in IBM PCs running on DOS/Windows. This helped the users and with the availability of software to meet virtually all needs of the users more and more users preferred systems using DOS/Windows than Apple Computers (Macs). Although technically Mac is a superior system, and Apple provided GUIs much earlier than Microsoft, Mac could never get a significant share in the market, where Microsoft ruled the roost. Thus by engaging in both producing the computers and the relevant software, Apple, prevented the Mac OS gaining a greater share in the market. Over the years Microsoft expanded the software range it offers and thus retained its position. Ironically it is Linux which is emerging as a threat to Microsoft, and not Apple (Mac). The Microsoft strategy paid off, because, it made a strategic use of its product. The product was protected by stronger IP rights but Microsoft wisely did not lock it with a particular hardware.

The aim of the FOSS model would be thus to create more value from the resource or source, by using licensing and IP rights wisely, than to lock it up with a particular system or a user. The FOSS model will focus on the fact that a resource can have more than one use, and, by adopting a strategy, than can make use of both uses, it is possible to maximize the benefit or revenue, than, by concentrating on one value. For example a source code can be used to develop software or can be used as a part of software or can be used as, software with some modifications. The uses and the relative demand of the uses will determine what policies the developer should adopt. The developer can determine what conditions (s)he can insist on depending upon the relevance of the source code in other applications. Thus, increasing the use value of the source code or resource can be an objective. By achieving this maximizing the economic benefit may be possible.

The value of a genetic resource may lay in its unique qualities and these qualities can be exploited in many ways. For example an elite germplasm may have the quality of drought resistance or insect resistance. Plant breeders often use germplasm from various countries, with specific traits to develop plants. This cannot be achieved if they rely on a single breeding line or germplasm.

The FOSS model could flourish because it could harness the creative potential of so many developers simultaneously without the need for an elaborate hierarchy or management structure. The work of Benkler highlights this and analyses how some of the common problems relating to agency, co-ordination and management are tackled in such projects. Others have also studied this aspect. But the question can this be extended or replicated in other areas or problems also. It is possible to do so, but it should be understood that FOSS model also needs co-ordination, project management and delivery of a solution. The only difference is FOSS model tackles this in a different way. Thus in extending FOSS model to other areas also the problems need to be tackled creatively. In most software projects there will be a project leader and in FOSS, the project leader is often who guides a community and hence has earned the esteem and confidence of the community. However there need not be a project leader in all projects/initiatives in other areas.

There can be a lead agency which could do this function. Basically lead agency can perform the tasks listed below:

1. Create a community of users/developers and provide guidance, motivate them and act as a coordinator;
2. Establish the base resource or the initial material to build upon and manage it, devise appropriate licensing agreements and IP policies and oversee distribution of the resource, avoid duplication and mediate in conflicts and assess the overall progress of the project/initiative.

This involves designing appropriate FOSS model which can meet the different needs of users and be compatible with the objectives. The FOSS model for a participatory plant breeding model may vary from that a traditional plant breeding project. In software projects it is always easy to work on an available source code than to begin from scratch.

Since the esteem and credibility of the coordinator are important, it is essential that the lead agency has earned these already or is not seen as a proxy of some other agency. The challenge is in building a community of users/developers and enabling them to function without friction or least friction.

FOSS model can help in maximizing benefits from using IP in some contexts. In some other contexts FOSS model will give a distinct advantage over those who use stronger IP protection. But what is very important is which business model is chosen and in combination with which IP policy. In software there are many successful business models.

But whether such models are adaptable in other contexts? Which FOSS license is suitable? But this question can be answered only if the overall business plan or objective is known. Again it is possible that a company may adopt FOSS model for one division or line of products, while, other divisions may be using a more restrictive IP policy coupled with licenses and agreements.

Thus a computer manufacturer may offer Linux bundled with a product or can offer a Open Source Product as a part of the hardware or system or as part of custom built with software, even, while, insisting on restrictive agreements and restrictive IP policy in other divisions. So what is important is how the FOSS model is sought to be implemented within the overall business strategy and whether it is compatible with the goals and objectives. The various licenses under FOSS create various rights and place some restrictions. It is possible to combine them and arrive at a model. For example a FOSS model may permit a single user to modify and use the software provided it is not commercially sold and is used for internal purposes only. A license may permit bundling a FOSS product with another product as long as the rights of the user are not restricted and source code is also offered. Another license agreement may even give the user the right to claim IP rights similar to copyrights, but, deny right to patents. A research tool or a resource may be licensed to be used in product development without royalty if the product is sold at no profit, no loss basis. Thus it is possible to devise a combination of licensing agreements in a FOSS model with clearly laid terms.

For example a FOSS model can be tailored to meet the needs of researchers and non profit organizations which may be permitted to use a research tool or a resource without restrictions for experimental purposes. A FOSS model can be designed for use of a research tool or resource, for commercial purposes, in which a licensing agreement can permit its use under a scheme for royalty, but without the right to restrict the use of the research tools, or resource by others. For example, a breeder can offer the inbred lines or germplasm to different users under different conditions. The breeder can impose conditions on a commercial breeder with the aim of maximizing revenue, in case, of successful development of varieties, while, he may allow, a university or a non-profit organization to use the resource for further development without any licensing fee. The breeder will own the germplasm or inbred lines but they are licensed under different conditions.

In biotechnology, the business method/models is use are similar to FOSS models but are not identically the same. The model is designed on the basis of objectives, than with the aim of adopting FOSS model per se. For example a consortium can have a FOSS model for sharing a resource among the members of the consortium with the objective that members should not act in a manner hostile to the interests of other members and to prevent one member gaining undue advantage. But the consortium can use another model for sharing the same resource with non-members of the consortium. Similarly research institutes can use a FOSS model to regulate access and transfer of materials among themselves but can adopt a different model while regulating access and transfer of materials with commercial entities. Hybrid models which have some aspects from open source model and some from other models have been in vogue in software.[27]

Open Source Models

According to Eric Raymond the following models would work well for Open Source 1) market positioner / loss leader; 2) widget frosting; 3) give away recipe/open restaurant; 4) accessorizing; 5) free the future, sell the present; 6) free the software/sell the brand; and 7) free the software/sell the content.[28]

Market Positioner/ Loss Leader offers open source products and services in addition to traditional products and services and used open source as a strategy to attract customers or to add value to existing products and services. For this type of business model the major source of revenue will be traditional products and services and although open source may not result in profit or even in a loss it gives some advantages. A proper mix of open source and non open source licensing can be used. An example of this can be a hardware manufacturer or service provider who incorporates open source software in the hardware or extends support to open source software in addition to supporting a typical commercial application. Using open source can help in gaining market share or in making specialized products and services available. The question of value addition is important and value addition can be done by a suitable combination of non open source and open source licenses. But the open source component unless it has significant advantages it does not make sense to offer that. One option can be to hive off open source to a separate business unit which can act as a supplementary service provider or seller. But although there may not be a profit offering open source can result in long term benefits.

Widget Frosting : This model is particularly relevant in case of hardware seller who focuses on hardware sales primarily but offers open source as an addition at no cost or provides support for the same as a part of the standard service support. There is a similarity with a loss leader as open source can be used to enhance sales and revenue. Whether the advantage arises from cost or value addition is this model depends on the product and services offered. It is possible to bundle different products and services depending upon the criteria decided by the customer. A technically savvy customer may not need much support for software and hence will weigh the hardware costs alone where as institutions may prefer after sales support also. It is possible for the vendor to differentiate customers based on their needs and price accordingly. The use of licenses depends on the products and services and it is most likely that in this business model simple licensing is enough.[29]

Give away recipe/Open Restaurant: The Red Hat business model is an example of this. Under this the value addition comes by selling the tested software which is guaranteed to work. The various versions of Linux are supported like this. The software developer earns revenue by installation, support and maintenance.

Accessorizing: Under this the revenue comes from providing accessories for software which could range from manuals/documentation to publications that help developers and users to maximize the potential of open source. This can be provided by the develop himself/herself or by companies like "O'Reilly Associates which has published many reference books and guides. This is a simple business model and there is no need for any specialized license. In one sense accessorizing can include any related activity ranging from providing T-shirts with Open Source Logo to production and distribution of publications.

Freeing the Future, Selling the Present: Under this model the short-term monopoly rights are asserted under a license but the source is placed under a more liberal/ less restrictive license after a period. During this period the developer tries to maximize his revenue. This is similar to a copy right with a limited term after which the work is made available on easier terms although not all rights of the author are given up. After the specified period the right to produce derivative works is available to the public. This model tries to strike a balance between the right to alter the source and produce derivative works and the right of the author to maximize his profit within a short time.

Freeing the software, selling the content: In this the open source is used as a means/method to offer something else or to provide some other good or service.

Freeing the Software Selling the Brand : In this the idea is to build the brand to assure that the software is tested and tried and the brand name distinguishes it from others. There can be various versions of Linux Operating Systems and although all of them may have common features each brand will be marketed emphasizing its unique features or added advantages or exclusive benefits and the various versions for various categories of users can be offered under a single brand. Thus although the software may be free or available as open source, the brand name helps the user to identify the developer and features of the software. The business implication of this is that brand building can be a marketing tool but unless the quality is assured the brand name alone will not work. These seven models have been suggested with software industry in mind and hence the examples/business approach has been drawn from them. So it is suggested that these models need not be duplicated elsewhere but can be used to give an idea about the possible models in other sectors. In the context of biodiversity, germplasm conservation, plant varieties and indigenous knowledge the models need not be limited to the seven models as above. Instead the need would be to identify and build new models that are workable and appropriate in the contexts for which they are developed.

It is not argued that the above seven models or business models in FOSS can be applied elsewhere or duplicated elsewhere. FOSS model gives us some insights and guiding principles that could be used to stimulate innovations, to fashion out alternative IP regimes, to reduce the negative impacts of the present day IP regimes and to develop new methods of production, and distribution of goods and services.

Thus FOSS is neither a panacea nor FOSS is a single framework that will fit in all contexts. It will desirable if IP can be used as a means or as a part of strategy than an end by itself. However in some cases it will be necessary to go all out for patents and other IPRs so that IP is not used as a strategy to block access or to enclose what is in public domain or to privatize what is in public use.

Biotechnology, Patents, Commons and Anti Commons – 1

Before proceeding to examine application of FOSS models the issues relating to commons, anti-commons, and freedom to operate in the context of plant genetic resources/plant breeding need to be discussed. The questions relating to anti-commons in scientific research arise due to many reasons, particularly because of broad patents on research tools and the tendency to patent key processes, techniques and genetic components and to build patents around important processes so as to block research by others and to use this monopoly as a strategic advantage.

With the rise of the biotechnology in the late 1970 and 1980s the race to patenting gained more momentum. Important decisions and policy changes in the 1980s stimulated further investment in biotechnology and IPRs emerged as a key factor and the range and breadth of patent claims also expanded.[30] Patents on research tools were also on the increase and as this is discussed later, an analysis is not given here.[31]

On one hand the IPRs helped to attract investments in biotechnology R&D and stimulated research and on the other hand the explosive increase in the number of patents in biotechnology also gave rise to many concerns about the social, ethical and economic implications of this trend.[32]

The debates on morality and ethical aspects of patenting are important but for reasons of space this is not discussed in detail. In 1973 two scientists in the USA created the first genetically modified organism and five years later the company they formed Genetech, came out with synthesis of human insulin. When Genetech went public it created a history and, soon biotechnology start ups attracted the attention of venture capitalist and investors. Many such companies were established by scientists based in universities and the initial issues were often successful. However over a period of time many of the start ups failed to commercial viability for one reason or another, and as a result were either bough out by larger firms in other sectors or were absorbed by other firms or became a subsidiary to another firm. The failures of the start ups did not deter investment in biotechnology but the failure and the mergers were looked upon as a stage in the process of maturation. In 1980 two significant developments took place and both helped in the growth of the biotechnology by expanding the scope of IPRs and by bringing a policy that favored further research and gave incentives for IPRs in biotechnology.

It would be no exaggeration to say that the majority judgment given in Diamond vs. chakraborty resulted in a paradigm shift in granting patents over living organisms, particularly genetically modified organisms. Prior to this the US PTO had refused to grant patents on living organisms and the products of nature doctrine were invoked as a rationale. Under this while processes for extraction, isolation and purification of products found in nature can be patented but products themselves cannot be patented as they were not considered as inventions. This was a well settled doctrine and the differentiation between processes relating to products of nature and products of nature was maintained.

This doctrine came under scrutiny in this case. The question was whether a patent could be granted on genetically modified bacteria that could clear oil slick. The US PTO refused to grant patent and the case finally reached the US Supreme Court gave the historic decision. It declared that "everything under the sun made by Man" could be covered under patentable subject matter. Hence the genetically modified organism could also be patented. The Supreme Court's decision was hailed by the nascent biotechnology industry but was also criticized by many who feared that it amounted to legitimizing patenting of life. It is significant that of the ten amicus curiae briefs, nine were in support of the stand taken by biotechnology industry. The Court ruled that a human made microorganism is patentable subject matter as a "manufacture" or "composition of nature". Thus the majority opinion was the genetically modified microorganism was "not nature's handiwork, but his own; accordingly it is patentable subject matter." [33]

In the majority opinion the Judges reasoned that human agency played the key role in transforming something occurring in nature and the result was not a product of nature but the outcome of handiwork of man and so "a live human-made organism is patentable subject matter." This was in contrast to the earlier view that combining bacteria was a discovery and not an invention.

The subsequent decisions Ex parte Hibberd 1985 and Ex parte Allen (1987) have been discussed by us elsewhere in the chapter on seeds. The grant of patent on oncomouse in 1988 indicated that the matter has been settled once and for all and patenting of biotechnological inventions became a routine affair, although many patents were contested and were subject to costly and protracted litigation. Having said this let us make it clear that there is no universal rule on this. As late as 2002 the Canadian Supreme Court gave a verdict stating that a patent on oncomouse could not be granted. The interpretation of TRIPS on patenting Genetically Modified Organisms is a contested one and not all countries are permitting patenting on life forms or patenting biological processes. But what is important is that the decision given in Diamond vs. Chakraborty gave a boost to funding and research in biotechnology and resulted in a new understanding/interpretation of patentable subject matter.

If the decision gave a new impetus to biotechnology industry an Act passed in the same year redefined the way universities and research institutes funded by the US government or its agencies handled intellectual property. The Patent and Trademark Law Amendments Act, popularly known as the Bayh- Dole Act passed in 1980 gave a new impetus to commercializing research and changed the way IP was perceived by universities and research centers. After the Second World War federal funding to scientific research increased rapidly and the vision Science as an Endless Frontier was articulated by Venevar Bush in 1948. Although the funding increased over the decades it was felt that commercialization of such research and transfer of technology had not taken place, commensurate with funding levels and the output. Under the Act universities and small businesses were given the option to become owners of the inventions arising out of federally funded research. They could also grant exclusive license if the licensee could commercialize the invention. The government was entitled to a royalty free non exclusive license to make use of the invention by government. This Act played a key role in university-industry research partnerships and in life sciences many licenses were granted, with National Institute of Health being the major funding agency. The Act created conducive milieu for such partnerships for it permitted universities to own inventions and to grant licenses, and this created a certainty about the ownership and transfer of technology. With uniform procedures and clear cut guidelines it was possible to enter into commercial agreements and industry was willing to invest in R&D at universities as it was assured that universities would be granting licenses and the firm can have exclusive access to the invention. In other words it could be argued that this Act although was directly concerned with funding scientific activities, it offered an incentive to innovate. Mowery et al conclude that this Act is partially responsible for the spurt in the number of patents obtained by universities since 1980. In 1981-85 patents awarded to inventors who assigned them to universities constituted a mere. 59% of total number of patents, but, by 1996-200 this has increased to 2.15% of total number of patents.[34]

Interestingly in the Chakraborty case the biotechnology industry argued that patents on living organisms would be an incentive to disclose the results of research. This claim was based on the fact that patents disclosed scientific information which otherwise might not be available. With the availability of patents, the patentee would disclose the research as (s)he had to disclose the same for grant of patents. The question is, whether patents are the right mode for disclosure. In return for the disclosure the patentee is granted an exclusive right. Thus the disclosure is balanced by the exclusive right. On the other hand disclosure would still be possible in many ways without exclusive rights. The results could be published in scientific journals or disseminated as reports/ working papers or as conference papers. Thus the argument that patents provided an incentive to disclose was valid to an extent only.

These two developments transformed the research landscape, particularly in life sciences in the USA. Over the last two decades in most developed countries policies relating to IP claims by universities and industry-university collaboration have undergone a sea change and universities have emerged as centers for facilitating commercialization of research and many start ups in hitech areas were based in universities. Universities also aggressively sough IP rights, defended IP claims and engaged in litigation over IPRs

There is an extensive literature on biotechnology and patents and the importance of patents for biotechnology industry. One major issue is whether patents particularly broad patents prevent further innovation. Since mid eighties Rebecca Eisenberg through many articles, written as a single author or with others has discussed the various issuers relating patents, including patents and its impacts on scientific research. In the paper titled as "Proprietary Rights and the Norms of Science in Biotechnology Research", published in 1987 she examined the interface between proprietary rights in biotechnology and norms of science. Scientists disseminate their research in many ways, but publications in peer reviewed journals are considered as important sources of information. But once disclosed publicly getting a patent based on that is not possible. The conflict between disclosure and appropriation through IP claims is evident. Examining this she argued that the tendency to patent might delay publication and as a result the delay in availability of research data and information might affect research by others adversely. Most of the scientific publications arise out of research at advanced stage, but this would not be sufficient to apply for patent protection and hence applying for patenting would be possible at much later stage only. Although as applying for patents warrants disclosure, there is a disincentive to disclose information and research results through publications, if the intention is to apply for patents. Trade secrets can also be sought as an IP right. Disclosure through patents also gives exclusive rights to patentee. She further argued that this exclusivity has greater adverse impact on applications relating to research than to commercial applications. Exclusive rights over research tools and techniques give an edge over other researchers. The researcher with exclusive rights would be reluctant to grant licenses to other researchers, and can enforce his rights to prevent others from proceeding in research by denying licenses in occasions where such research would undermine the value of his/her work and by preserving exclusivity (s)he can not only prevent competition but can also stake his/her claim as the first to invent. An important issue is whether research exemption is available for other researchers, particularly when there is no commercial orientation in the research. This aspect was examined by her in a paper published in 1989. In that paper she argued that if the research were construed narrowly it would stifle further research but a too broad research exemption would result in companies losing interest in investing in research and they might opt for trade secret as an option. She also pointed out that exemption for experimental purposes could be invoked strongly in cases where the user was trying to create alternatives to the patented invention or was testing the adequacy of the patent specification or validity of the patent claims and was weakest when the invention was used a mere tool in an non related research field/activity. The pioneering research by Eisenberg in the late 1980s anticipated some of the hotly debated issues, particularly the adverse impacts of patenting of research tools and the question of research exemption in patents. Although the later issue has been settled by decision given in Madely vs. Duke the controversy is far from over.

In the 1990s there were controversies over patenting gene fragments, gene sequences and specific components of genome. Although during the late nineties the controversies arose in the context of sequencing human genome and seeking IP claims on the same in 1991 the decision of National Institutes of Health to seek patent claims on cDNA also known as Expressed Sequence Tags (EST) provoked much discussion on the patenting of the same and access to information and sharing of data relating to human genome. The decision was rescinded later and NIH dropped the idea. But concerns over the patents on research tools, broad biotechnology patents, patenting genetic information and gene sequences were expressed by many and this resulted in studies/symposia on the related issues. At the same the questions became to criteria for patenting and the subject matter of biotechnology patents was also hotly debated This debate was not confined to USA alone as the EC tried to adopt the Directive on Biotechnological Innovations and there was an aggressive campaign in the Europe against what was called 'Patenting Life'.

Heller had argued that where multiple owners have exclusive rights and if the owners failed to allow on bundling of rights , resulting in effective utilization by some one, then there is a tragedy of anti-commons and the resource may be under utilized. Heller made this argument in the context of a scarce resource.[35] In another article Eisenberg and Heller discussed about the 'tragedy of anticommons' where the existence of numerous property rights claims over the building blocks needed for further research and development results in a situation that is not conducive to further innovation. They argued that when property rights are diffusely held by many owners the negotiations to bring these building blocks together can fail. This will result in blocking or acting as a barrier to further innovations. The increase in the patents on biomedical research tools on genetic inventions can thus may result in the tragedy of anticommons, as it is difficult for researchers to pool licenses on all the technologies relevant/needed for further innovation.[36]

The tragedy of anticommons is a reverse of the tragedy of the commons idea propounded by Garret Hardin in his well known article in 1968. This influential article evoked varied responses and some of the assumptions on the tragedy of commons were questioned by researchers on common property resources.[37] Interestingly one of the solutions suggested to avoid tragedy of the commons is to provide property rights and to create mechanisms that enforce the same. In the tragedy of anticommons it is the proliferation of (intellectual) property rights that is the major cause for that situation. Thus prima facie property rights per se need not be a viable solution. Incase of the tragedy of anticommons it was the proliferation of the number of patents on biomedical research that led to this situation. Heller and Eisenberg point out that one reason for this proliferation was the judicial expansion of the subject matter for which patents can be granted.

With the increase in number of patents, the transaction costs for users who need access to input covered by patents increases significantly. Heller and Eisenberg point out that this can reach a point where effective utilization of the resources is not possible. One consequence of such a situation is that downstream development of further innovations is affected. The following example indicates how in real life the transaction costs and patents on biomedical inventions affect research done by universities etc.

Cre-lox is a gene-splicing tool patented by Harvard University and under exclusive licence to DuPont Pharmaceutical Co. It allows researchers to make knock-out mice by deleting a single gene from specific cells and is very useful for identifying gene function. DuPont initially asked that public-sector researchers sign an agreement that would limit their ability to use and share the Cre-lox technique and that would subject their articles to pre-publication review by the company. In addition, DuPont wanted commercial rights to future inventions that might arise from experiments involving Cre-lox animals (i.e. reach-through rights). While at least 150 universities and non-profit organisations agreed to these terms, some prominent institutions, including the NIH, refused, claiming they created obstacles to biomedical research. The issue was resolved in the United States in 1998 with a memorandum of understanding between the NIH and DuPont (and separate agreements with academic laboratories), which simplified access conditions for the US public sector to this patented research tool.[38]

The increase in transaction cost is only one of the aspects. There are other issues like research-through rights and exercising control over the use of research tools. The research tools issue has been studied extensively, inter alia, by Eisenberg, Hilgratner.[39] The impacts of patents on genes for research and development need not be positive. Patents can act as deterrent to other researchers particularly in cases where the patent covers nucleic acids or fragments that are essential for research.[40] But the opinion is divided as some researchers point out that innovation has not suffered even if patent related anticommons situation is prevalent in biomedical industry.[41] It has also been suggested that the anticommons is not a serious problem in research tools and the past experiences show that solutions can be found and as long as the criteria for patentability is met there should be no bar on patenting them.[42]

The point is that it is not that patenting research tools or granting patents over genes will always block further research. In many cases it has been found that the exclusive license holder has not prevented others from accessing the technology and schemes have been evolved to share the technology or to provide access to non profit and research organizations on flexible terms.[43] However this has not deflected the attention from the policy issues relating to patenting research tools and higher transaction costs involving using many patented tools and techniques.[44] It has been pointed out that although legally research exemption may not be available often patent holders do not sue universities and research institutions for various reasons, although this need not be the case always.[45]

The question of patenting research tools is closely linked to science as a practice and the role of intellectual property rights. Whether IPRs are compatible with the norms of science and whether they result in less open science and result in more commercial orientation in science are some of the issues. For reasons of space and as this beyond the purview of this thesis this will not be discussed here.[46]

The Freedom to Operate and Accessing Technology in case of Agricultural Research and Plant Breeding

In view of increasing use of biotechnology in agricultural research and plant breeding one important question is whether the patents on research tools, techniques, genes and gene fragments pose a threat to agricultural research, particularly in developing nations. The answer to this question is not obviously a straight yes or no. In patents the jurisdiction matters and the patent granted in one country does not grant the patentee rights in other countries.

And the criteria for patentability, the subject matter and the scope of the patent claims are again subject to national laws and rules. Thus while a research tool or gene patent may be valid in the USA and EC, but the same patent claim may not be acceptable in a country which does not grant patent claims. Moreover in case of plant breeding and seeds, the laws of different countries define the criteria for patenting and plant breeders' rights differently. But what is more important is that whether research is an exempted activity also varies from country to country. Thus whether research activity constitutes patent infringement cannot be answered except in the specific context. So it is quite possible that while a research tool may be patented and hence not available for research without the permission from the IP holder or through holder in a country say A, the same may not be patentable in country B. Still this does not mean that there are no problems for the user of the research tool in country B. The patent holder has exclusive rights and can hold up the research and development of a product which needs use or access to the technology covered by the patent.[47]

Defensive patenting is used by firms in some industries to build patent thickets and to gain freedom to operate.[48] The strategy of using defensive patent portfolio to gain advantages in negotiations with small players and newcomers in the field has been noted by researchers.[49]

In case of research which involves access to many technologies and research tools, thus the freedom to operate might be curtailed because of lack of access or non availability of licenses and hence product development and research may suffer. However for small start ups such patents are valuable assets. The patent gives them exclusive rights and thus the investor or venture capitalist is assured that the start up has freedom to operate in the domain of its expertise. It is also possible that a portfolio of patents can be built by a start up as a business strategy and to prevent others in engaging competitive research. Thus what can be an astute business strategy for one firm or company may hinder the freedom to operate of others who are engaged in downstream product development. In case of agricultural research, particularly plant breeding this is all the more complex because the genetic resource might have been obtained under a Material Transfer Agreement which might have put conditions on use and IP claims, and the various processes, tools, genes might be covered under different patents with different owners or holders of IP rights. Thus the freedom to operate is crucial for agricultural research. It is not necessary that all agricultural R&D or plant breeding experiments will be done for commercial purposes. So is there any exemption for research?. The answer again is subject to national laws and interpretation by courts. The rights of the patent holder include right to exclude others from making, using, selling, offering for sale or importing the patented invention or product is affirmed by TRIPS under Article 28.[50] This broad right to exclude has been justified on the ground that the monopoly rights under patents are essential to stimulate innovation and as patents result in disclosure, they help in dissemination of ideas.[51]

However the rights hinder building upon the patented invention. To ensure that research is facilitated exemption is provided to researchers, and this exemption is either sanctioned by law or by compulsory licensing. In the USA this exemption is a common law exemption.[52] On the other hand the European Patent Convention provides for research exemption in Article 27(B). Different countries follow different approaches but as the ruling given by WTO Panel confirmed that experimental use exemption is compatible with TRIPS as long as some condition is met, and so, it can be concluded that there is no bar per se on this exemption.[53]

However the scope of the research exemption in the USA is very limited, even for academic/non commercial purposes. But after the decision given in Madey v Duke University it is clear that there is no research exemption and universities or researchers cannot claim any such exemption whatever may be the purpose. This has effectively overturned the idea of experimental use defense.[54]

Regarding use for educational purposes it was held in Ruth v Stearns-Roger Mfg Co, that there was no infringement if the patented invention was used for nonprofit educational purposes. In Roche Products V. Bolar Pharmaceutical Co the experimental use exemption was questioned and the U.S. Congress passed Hatch-Waxman Act which s.271(1)(e). In effect the Act overruled the decision given in Roche and thus exempted from infringement making, using or selling of a patented invention for specific purposes i.e.." solely for uses reasonably related to the development and submission of information under a Federal law which regulates the manufacture, use, or sale or drugs".

This exemption again is a very limited exemption. Thus as far as the law in USA is concerned there is no research exemption per se, irrespective of use, except in some specific contexts. The research exemption is not allowed even for "legitimate interests" of the government (Pitcarin V. United States 547 F.2d 1106 (Ct.Cl.1976), cert. denied 434 U.S 1051 (1978). Even the non-commercial activities of the government are not exempt.

Thus it is very difficult to defend use on the grounds of research or for non commercial purposes. It is also difficult to distinguish between non commercial and commercial purposes. In case of universities although they are educational and research institutions they are not exempt and many universities engage in commercial research, own/acquire IPRs in their name, grant licenses and encourage faculty to apply for IPRs and also have policies regarding IPRs. Whether an institution in engaged in commercial activity or not experimental use defense cannot be invoked as this has been made clear in Madey Vs. Duke University.[55]

And of course as noted earlier post Bayh-Doyle Act the universities and research institutions are not barred from obtaining patents or from commercializing inventions. Another factor which has made the distinction non existent is the increase in the corporate funded or private-public sector research being done at universities. A well known example of this is, alliance between Novartis through Novartis Agricultural Discovery Institute and The University of California Berkeley, in which $25 million was to be spent over a period of five years. Such deals evoked mixed response and the critics argued that universities are losing their focus and are becoming commercially oriented and it was feared that increase in corporate funding would result in the 'kept university'. Concerns have been expressed about the negative impacts of commercialization and industry sponsored research. [56]

Thus accessing patented technologies without licenses or other arrangements would amount to patent infringement unless such activities are expressly permitted by the law, for research or non commercial purposes. Under the European Patent Convention, patent protection is not applicable to "acts done privately and for non-commercial purposes" and also for "acts done for experimental purposes relating to the subject matter of the patented invention". [57]

Hence accessing others technologies is not an easy task where such technologies are patented and there is no exemption available under law. In the USA research exemption is available under U.S. Plant Variety Protection ACT (PVPA) 7 USC 2321 et seq , and under this a protected variety may be used or reproduced in plant breeding or in other bona fide research. The UPOV Convention 1978 provided for such an exemption but the 1991 Convention which had broadened the scope of the breeders' rights has eliminated that exemption.

Even the exemption under PVPA is more of academic value than of any practical consequence as it has been held that patents can be used to protect plant varieties and hence once the variety is protected under patents the applicability of exemption under PVPA is doubtful. The decision given in J.E.M Agro Supply has implications for academic research. [58]

Hence the question is there any "free access" or absolute 'Freedom to Operate'. The answer is perhaps no. Access is not denied per se, but licenses are granted with restrictions or with hidden costs. The access to genome sequences are also restricted or conditions are imposed, and hence the 'Freedom to Operate' has to be negotiated than taken as granted or as an option with no restrictions.[59]

Material Transfer Agreements are the primary vehicles for negotiating transfer of germplasm, cell lines, vectors and clones between institutions. MTA can be a document listing the conditions of transfer or can be a communication (letter/memo) stating the conditions. Generally most MTAs forbid further transfer of material without permission and may impose conditions on IPR rights to be claimed by the institution which seeks the material covered by MTA. However whether such conditions are binding or legally enforceable is not clear. It has been reported that although many MTAs were agreed and signed the centers under CGIAR failed to monitor whether the conditions were met or whether any IPRs were obtained on the germplasm transferred. [60]

Thus the mere existence of MTAs does not guarantee that the conditions will be scrupulously followed. The handling of MTAs involves costs and too many MTAs for a single research project will increase the transaction costs. But irrespective of MTAs accessing technologies involves analysis of the ownership of tangible and intellectual property rights (TP/IP).

As plants and products are constituted of many components and processes it is essential particularly in the context of agricultural biotechnology and transgenic products to identify the essential components and examine the IP/TP rights related to them. This is the first step before embarking on a FTO analysis. The following points need to be taken in to account by scientists before deciding about FTO.

(1) Knowing what one has and where it's from, (2) organizing material transfer agreements and licenses, (3) researching scientific and patent databases and relevant literature, (4) instituting a laboratory notebook policy, (5) keeping track of ownership of germplasm and plant genetic resources, and (6) promoting ongoing IP/TP management, awareness and training.[61]

Thus the FTO analysis may reveal that the licenses and other permissions required for the project. Why such an extensive exercise is needed is exemplified by the research leading to the 'Golden Rice'. Kryder et.al. have identified 70 patents associated with this technology , including process patents and product patents.[62] Negotiating with patent holders and obtaining licenses and organizing MIAs would have made the research project very difficult. But as AstraZeneca and Monsanto adopted a licensing policy that was favorable to research without restrictions the IP issue did not become a bottleneck. Still this indicates that on the whole determining FTO is a complex affair. In this case most patents were granted in USA or Japan.[63] The intended beneficiaries of this project are in countries which have not granted many patents relating to rice. So technically it is easy for research institutions to make use of this technology once it is transferred, without bothering much about the IP angle. But when this rice is exported to USA or Japan it is most likely that patent holders will object to that as licenses were granted with specific conditions. Further under TRIPS such an objection will be valid. So the Freedom To Operate issue has to examined from the IP angle. To say that IP issues circumscribe the FTO is not an exaggeration. And implementation of TRIPS has made the matters more complicated.[64]

Due to combination of many factors like increase in private sectors involvement in research and development, the decline or stagnation of funding for international agricultural research under CGIAR, the decline or reduction in the funding on plant breeding and agricultural research in public sector in developing nations, the changing roles of the public sector and private sector in agricultural research , plant breeding, seed development and distribution, the proliferation of broad patents and the rapid increase in the number of patents on products, processes, techniques and research tools the research landscape has undergone major changes within the last ten years. A discussion of many of these factors is beyond the scope of this discussion and hence the relevant literature is not cited here, nor an analysis is provided.

The developments in IPRs cut both ways. On one hand they induce further investment, guarantee freedom to operate to start ups, enable strategic use of patents, help in the use of patents as a defensive strategy or use of patents as an asset in negotiations/bargains, and, help in development of firms specializing in research tools or specific domains. But the potential for the tragedy of anticomons has been highlighted and broad patents and patenting of key processes and technologies are not conducive to further research and innovation and affect the freedom to operate, particularly those of non profit research centers. A detailed examination of the patent system and the above trends is not done for lack of space.

Some solutions have been suggested to overcome the negative implications. Most of these suggestions are valid and some of them call for a rethink on the grant of broad patents and evolve steps to define research exemption broadly and also application of stricter criteria for grant of patents on genes etc. A detailed discussion on the same is not attempted her for that would entail an extensive discussion on patenting norms also, apart from other related issues. In the next chapter some innovative solutions are discussed and some new ideas are put forth.

Conclusion

Although FOSS is associated with software as a paradigm it offers much scope to find innovative solutions. FOSS could be understood in a broader context and as an alternative IP regime. The Open Source model discussed in this chapter will be elaborated upon in the next chapter. In this chapter some trends relating to patenting research tools and the implications of IPRs for Freedom to Operate was also discussed.

Notes and References

[1] The following books give an overview about FOSS and its emergence as an alternative.

Most of the information on FOSS given in this chapter is drawn from these and wherever necessary additional references have been provided. For reasons of space the discussion is limited to few topics on Open Source which are relevant for the dissertation. For example the relevance of Open Source in hardware or in devices with embedded systems is not taken for an analysis. Similarly the business history of Open Source is not given in detail, nor its success in IT sector has been examined in detail.

DiBona, Chris et al (1999), Mody, Glyn (2001). Raymond, E.S.(1999), Williams, Sam(2002), Pavlicek, Russell C. (2000), Rosenberg, Donald. K (2000).

[2] See - O'Rourke, Maureen A. (1995) for a discussion on different types of licenses in software field and the scope of copyright in such licenses.

[3] See Gomulkiewicz, Robert W. (1999)

According to FSF "You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program [any program covered by this license] or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this license". See also

Open Source Initiative, "Why "Free" Software is too Ambiguous":
http://www.opensource.org/advocacy/free-notfree.php

Free Software Foundation, "Why ``Free Software" is better than ``Open Source"': http://www.gnu.org/philosophy/free-software-for-freedom.html

[4] According to Kenndey (2001)

"The GPL has been referred to as part manifesto and part license, because in it Stallman spells out the underlying philosophy of "free software" and, to an extent, codifies his views about software. The essence of the GPL is revealed in its preamble: "when we speak of free software, we are referring to freedom, not price. Our general public licenses are designed to make sure you have the freedom to distribute copies of free software (and charge for the service if you wish), that you receive source code or can get it if you want it, that you can change the software or pieces of it in new free programs; and that you know that you can do these things." Here are the three essential components of free software: the right to distribute, the right to get source code, and the right to modify. The preamble refers to the restrictions in the license that protect these rights and also says that these protections "translate to certain responsibilities." To illustrate the effect of the GPL, "if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights you have. You must make sure that they, too, receive and can get the source code. And you must show them these terms so they know their rights." The GPL emphasizes that the terms be clearly known, in reaction to the restrictions often buried in the "fine print" of traditional commercial software licenses."

"The second philosophy for the production of software in commons is embodied in the GNU General Public License of the Free Software Foundation, known universally throughout the world by another three-letter abbreviation, **GPL. The GPL** says: We construct a protected commons, in which by a trick, an irony, the phenomena of commons are adduced through the phenomena of copyright, restricted ownership is employed to create non-restricted self-protected commons. ....It says: "Take this software; do what you want with it--copy, modify, redistribute. But if you distribute, modified or unmodified, do not attempt to give anybody to whom you distribute fewer rights than you had in the material with which you began."

Moglen, Eben (2004) at 7

[5] See Rosenberg, (2000), P 92 http://fscked.org/writings/OpenSource.html

[6] Diamond, David, Torvalds, Linus (2002)

[7] Lancashire, David (2001)

[8] For an in depth study see Weerawarana.S, and Weeratunga.J (2004)

[9] McSherry (2001)

[10] "Apache HTTPD, the Web server developed by the Apache Software Foundation now runs more than 69% of all active Web sites (representing nearly 15 million sites). The Microsoft Web Server (IIS) comes in a distant second (at a bit below 23%) [Netc 2003] and no other vendor's Web server has any significant market share. As a further testament to the success of Apache HTTPD, several major software vendors have dropped internal Web server products and adopted the Apache HTTPD

software for use in their higher level software products." P14 Weerawarana. S, and Weeratunga. J (2004).

[11] Williams, Sam (2002) 148-149

[12] "In this paper, we argue that the gift economy is important, not only because it creates openness, but also because it organizes relationships between people in a certain way. Open source software development relies on gift giving as a way of getting new ideas and prototypes out into circulation. This also implies that the giver gets power from giving away. This power is used as a way of guaranteeing the quality of the code. We relate this practice to how gifts, in the form of new scientific knowledge, are given to the research community, and how this is done through peer review processes." Bergquist, Magnus Ljungberg, Jan (2001)

(On gift economy and FOSS see Bergquist, Magnus Ljungberg, Jan (2001), see also Zeitlyn, D.(2003)

See also Bezroukov,N. (1999) http://firstmonday.org/issues/issue4_10/bezroukov/index.html Raymond, E.S. (1999a) For comparisons between open source communities and research communities.

See also Ippolito J. (2001), for gift economy, internet and domain name disputes. Gift economy is an idea which has been discussed in anthropology and cultural studies. For details see Frow, John (1997). Frow also discusses gift economy in a wider context. See also Bollier, David (2002). "Gift Economies" are based on collaborative mode of working, without strict profit motives have continued to exist despite market pressures etc in diverse contexts such as scientific research, schools, and libraries.

[13] Dalle, Jean-Michel , Jullien, Nicolas (2003)

[14] Linux is a classic example. . As Eric Raymond (1999) points out

"From nearly the beginning, [Linux] was rather casually hacked on by huge numbers of volunteers coordinating only through the Internet. Quality was maintained [. . . by the] strategy of releasing every week and getting feedback from hundreds of users within days."

[15] See, Weerawarana.S, and Weeratunga.J (2004), UNCTAD (2003) for examples. See also Story (2002).

[16] Dasgupta, P. and David, Paul. A. (1994).

The work of Paul David on IPRs is very relevant in the overall context of the arguments on negative impacts of IP. See David, Paul. A. (1993) and David, Paul. A. (2002).

[17] "Copyleft is a striking analog of the 'Science' while copyright belongs to the 'Technology'. The essential property of the copyleft licensing scheme is that it creates a particular incentive structure

within the business environment. This structure has properties that are equivalent to the incentive structures of scientific communities." Mustonen (2003)

[18] According to 17 U.S.C. 101 (2000) a computer program or software is a "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result."

According to David R. Syrowik and Roland J. Cole.

"A software-related patent is a patent that claims as all or substantially all of its invention some feature, function or process embodied in a computer program that is executed on a computer. Most types of software that have been patented include system software and various types of application software, including business software, user-interactive software and expert system software. In general, the functional aspects of software have been patented. Examples include processes, editing and control functions, compiling and operating system techniques and the like. With respect to design patents, icons and electronic font types have been patented" (A Primer on Software related patents) http://www.spi.org/primsrpa.htm last visited 10th April 2004.

[19] Since 1981 many patents on software have been issued, although the estimates of the number of such patents vary, it is shown that more than 11,000 such patents were sought in 1995 and more than 4000 patents were issued in the same year. http://www.spi.org/primsrpa.htm (last visited 24th April 2004).

See also Cohen and Lemley (2001) and Marshall J. (1998);

Some of the earlier articles on software patents and computer programs are : Oddi, A. Samuel (1993), Reichman, (1994) and Samuelson et al.(1994)

[20] Carvalho 2002 at 149.

[21] For example

In re Beauregard, 53 F.3d 1583, 1584 (Fed. Cir. 1995) (""Computer programs embodied in a tangible medium, such as floppy diskettes, are patentable subject matter under 35 U.S.C. 101 and must be examined under 35 U.S.C. 102 and 103.'"); In re Alappat, 33 F.3d 1526, 1545 (Fed. Cir. 1994) ("[A] computer operating pursuant to software may represent patentable subject matter, provided, of course, that the claimed subject matter meets all of the other requirements of Title 35."); In re Lowry, 32 F.3d 1579, 1583-84 (Fed. Cir. 1994) (Particular data structures are statutory subject matter because, "more than mere abstraction, ... data structures are specific electrical or magnetic structural elements in a memory ... that provide increased efficiency in computer operation."); In re Warmerdam, 33 F.3d 1354, 1361 n.6 (Fed. Cir. 1994) ("The storage of data in a memory physically alters the memory, and thus in some sense gives rise to a new memory."); Arrythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1060 (Fed. Cir. 1992) (Computer-performed operations that simply "transform a particular input signal to a different output signal, in accordance with the internal structure of the computer as configured by electronic instructions," are statutory subject matter.).

[22] .See Rosenberg, (2000). See also Pavlicek, (2000) ("The use of software patents has been a real problem in the Open Source world.); Stallman in Chris DiBona et al. eds., (1999) ("The worst threat we face comes from software patents, which can put algorithms and features off limits to free software for up to twenty years."), available at http://www.gnu.org/gnu/thegnuproject.html . Lessig, Lawrence (1999) ("What is "novel,' "nonobvious' or "useful' is hard enough to know in a relatively stable field. http://www.thestandard.com/article/display/0,1151,4296,00.html. See also Lessig, Lawrence (2002).

[23] "This Article has presented an argument that certain activities relating only to source code, such as copying, modifying, and distributing, may not infringe any third party software patent rights. Specifically, process and machine patents cannot be infringed until object code is either executed or loaded into the memory of a computer, and therefore they are not implicated by activities relating only to source code. Additionally, under Beauregard claims, "computer programs" that are embodied in a computer-readable medium could be narrowly construed to mean only object code, since object code, and not source code, is the only format "capable of being executed by a computer." The implication of this interpretation for the open source community is that activities that involve only source code, and not object code, such as open source security efforts, may be freely practiced without the concern of infringing software patents. Nevertheless, any time object code is implicated in an open source activity, software patents still remain "the monster hiding under every software developer's bed." Lin, Daniel, Sag, Matthew Laurie , Ronald S. (2002) at 257

[24] According to Benkler

'...I suggest that peer production of information is a phenomenon with much broader economic implications for information production than thinking of free software alone would suggest. I describe commons-based peer production enterprises occurring throughout the value chain of information production on the Internet, from content production, through relevance and accreditation, to distribution. I then explain that peer production has a systematic advantage over markets and firms in matching the best available human capital to the best available information inputs in order to create information products." Benkler (2002)

[25] "....the entire universe of peer-produced information gains no benefit from strong intellectual property rights. Since the core of commons-based peer production entails provisioning without direct appropriation and since indirect appropriation - intrinsic or extrinsic - does not rely on control of the information but on its widest possible availability, intellectual property offers no gain, only loss, to peer production. While it is true that free software currently uses copyright-based licensing to prevent

certain kinds of defection from peer production processes, that strategy is needed only as a form of institutional jiujitsu to defend from intellectual property. A complete absence of property in the software domain would be at least as congenial to free software development as the condition where property exists, but copyright permits free software projects to use licensing to defend themselves from defection" ibid

[26] "The Net is a superconductive medium for the creation of software. ...Moglen's corollary to Faraday's Law says wrap the Internet around every brain on the planet; spin the planet. Software flows in the network. It is wrong to ask, "What is the incentive for people to create?" It is an emergent property of connected human minds that they do create. The forms in which they create, like the evolution of spoken and written language, like the disposition of means, cultural forms, patterns of pottery, shapes of musical endeavor, and so on, are structural characteristics of the human mind. We are a social species, and we create together; that is our nature. The question to ask is, "What is the resistance of the network?" Moglen's corollary to Ohm's Law states that the resistance of the network is directly proportional to the field strength of the intellectual property system. The conclusion is: Resist the resistance." Moglen, Eben (2004) at 5.

[27] For example

"That is, some companies are releasing some of their software on an open source basis, while at the same time selling other products as proprietary software. Furthermore, some of these companies plan to support not only the Linux and open source world, but also to cash in on Microsoft's. Net initiative — thus bridging the gap between the two. ....In its hybrid approach, ActiveState plans to let programmers download the languages or use other open source versions of the languages for free, but will charge for commercial use of Komodo. Hardt hastens to point out that developers do not need to use its IDE with Perl, Python, or XSLT..... Crossgain plans to make some of its technologies, such as the components and development tools, available as open source code, but also to have some proprietary software. That's where the company plans to make its money." http://www.fawcette.com/Archives/premier/mgznarch/xml/2001/01jan01/sj0101XML/sj0101xml-8.asp

[28] Potter, W. (2000) The discussion on various models is based to a great extent on this article.

[29] According to Potter. W

Market forces have compelled hardware manufacturers to write and maintain software, such as device drivers. If they used open source software, their maintenance and writing costs could be placed on the open source community. As a result, "the vendor gains ... a dramatically larger developer pool, more rapid and flexible response to customer needs, and better reliability through peer review." At least one manufacturer has used this method: "Apple Computer [employed this model when] they open-sourced 'Darwin,' the core of their MacOSX server operating system." (ibid)

[30] OECD (2002) P. 9

"The traditional idea of an invention's commercial value has been altered from having an intrinsic value to having potential value in biomedical research as a therapeutic target. Companies and universities alike are filing patents on discovered genes in order to license them for scientific research or simply to ensure freedom to operate for internal investigation without threat of infringement. The IP of one protein family in particular is the focus of this review. G-protein-coupled receptors are proven to be important drug targets and therefore, the number of patent filings on the genes, proteins and uses of these receptors currently exceeds the number of receptors themselves." Vanti, W.B. et.al. (2001) (abstract)

[31] According to Eisenberg

"Research tools" is not a term of art in patent law. No legal consequences flow from designating a particular discovery as a research tool. Research tools are not categorically excluded from patent protection (except insofar as they lack patentable utility), nor is the use of patented inventions in research categorically exempted from infringement liability" National Research Council (1997).

http://stills.nap.edu/html/property/2.html#chap2

"The very term "research tool" connotes a user perspective rather than a provider perspective. What a user sees as a research tool, a provider may see as a valuable end product for sale to customers. A striking example of this difference in perspective arises when a scientist in a university wants to use a candidate pharmaceutical compound in research. From the perspective of the university and the scientist, the compound is a mere research tool, potentially useful in making future discoveries. But from the perspective of the firm, the compound may be a very precious end product, the payoff from significant investments of time and shareholder dollars in its own research.
The label "research tool" may apply less equivocally to the multitude of biological discoveries that precede the identification of new therapeutic compounds, including DNA sequences, databases, clones, cell lines, animal models, receptors and ligands involved in disease pathways, or laboratory techniques used to create or identify these discoveries. But even these "upstream" discoveries might seem like commercial end products to the institutions that discover them. Some of these materials might ultimately prove to be therapeutic or diagnostic products in their own right, marketable to consumers for use outside the laboratory. Others might have, or appear to have, sufficient commercial value as resources for use in the discovery of future products to motivate some firms to invest in their identification and development for sale or license to other firms for use in further research. What counts as a research tool and what counts as an end product thus varies from one institution to the

next. Inevitably, each institution minimizes the value of the discoveries it borrows from others, while seeing great value in its own past and future discoveries" Derzko (2004) at 351,352.

[32] See Rimmer, Matthew (2003) for a 'social history' of patents and biotechnology.

[33] Once can compare this with the observation made by Justice William O. Douglas in 1948 in Funk Bros. Seed Co. v. Kalo Inoculant Co. Since this has been cited in another chapter it is not repeated here.

[34] Cited in Sampat (2003). See also Rai, Arti K, Eisenberg, Rebecca S. (2003).

[35] Heller (1998)

[36] Heller, M. and Eisenberg, Rebecca (1988) Eisenberg, R .S. (2001).See Walsh, Patenting of Research Tools and Biomedical innovation

http://www7.nationalacademies.org/step/STEP_Projects_IPR_Oct_2001_Presentations.html

Also Koneru, Phanesh (1998) for arguments favoring patenting research tools and with less stricter criteria for utility).

[37] For an over view refer to the citations in the chapter on biodiversity on tragedy of commons and common property resources.

[38] OECD (2002) at P15,

[39] See OECD (2002) for an overview of the studies on this See Kimpel, Janice A. (1999) also.

[40] "Many feel that by allowing genetic information to be patented, researchers will no longer have free access to the information and materials necessary to perform biological research. This issue of access to research tools relates to the ability of a patent holder to exclude others from using the material. Further, if a single patent holder has a proprietary position on a large number of nucleic acids, they may be in a position to 'hold hostage' future research and development efforts."

Clarke, J., J. Piccolo, B. Stanton and K. Tyson (2001)

[41] Walsh, John.P et. al. (2003).

[42] Ramirez, Hamme Heather (2004)

[43] OECD (2002).

[44] Eisenberg (2001)

[45] Cai, Michelle (2004) provides an analysis of this.

[46] See Royal Society, The (2003), Dinwoodie G.B.; Dreyfuss R (2004). See also Rai,Arti Kaur (1999), Rai, Arti Kaur (2001), Keiff (2001). A discussion on norms in science, Merton's views, and scientific practice and IPRs is beyond the scope of this chapter.

[47] "A patent claiming a gene as a composition of matter provides a far-reaching monopoly on the gene. The gene patentee can control any use of the patented gene whether in diagnostic testing kits, gene therapy vectors, or expression vectors for protein production. In other words, the patentee's right to exclude permits domination of related and subsequent inventions using the patented gene. For example, an inventor other than the patentee may patent a gene therapy vector, but may be blocked from operating under the gene therapy patent without a license from the patentee holding the gene patent.

Dominating gene patents provide their patentees with an enviable position in licensing negotiations. ....However, if bargaining breaks down because of mistakenly high valuation or an irrational moral claim based on pride or spite, the blocking patent provides opportunity for "hold-ups." For example, the gene patentee's refusal to grant a license on a gene used in a new method for purified protein production restricts the protein production patentee's freedom to operate under his patent without fear of infringement litigation. Due to the unique interdependence of a gene with upstream and downstream biological events driven by other genes and gene products, fair and efficient licensing of gene product patents becomes a critical feature in an effective patent system" Hill, Laurie, L. (2003) at 234

See Hemphill (2003) also

[48] According to two researchers firms in semiconductor industry

"Appear to be engaged in 'patent portfolio races' aimed at reducing concerns about being held up by external patent owners and at negotiating access to external technologies on more favorable terms" Hall, Bronwyn H. Ziedonis, Rosemarie H (2001) at 104.

[49] Wegner, Harold C., Maebius, Stephen B. (2002).

[50] According TRIPS Article 28.

A patent shall confer on its owner the following exclusive rights:

1 (a) where the subject matter of a patent is a product, to prevent third parties not having the owner's consent from the acts of: making, using, offering for sale, selling, or importing for these purposes that product;

(b) where the subject matter of a patent is a process, to prevent third parties not having the owner's consent from the act of using the process, and from the acts of: using, offering for sale, selling, or importing for these purposes at least the product obtained directly by that process.

2 Patent owners shall also have the right to assign, or transfer by succession, the patent and to conclude licensing contracts.

[51] Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 145, 489 U.S.P.Q.2d (BNA) 1847, 1850 (1989). The reward doctrine holds that patents are rewards for contributing to progress and for disclosing the inventions. Mossof, Adam (2001) for a historical overview of the idea of patent monopoly. See also Sandstrom, Kevin (2004)

[52] Sandstrom, Kevin (2004)

[53] "Furthermore, since the decision has revealed to all WTO member countries that an experimental use exception forms part of the patent law of many countries, it may well accelerate the adoption of such a provision in any country in which such an exception does not yet exist." Derzko (2003).

[54] In Whittemore v Cutter, Storey J. held that:

"It could never have been the intention of the legislature to punish a man, who constructed such a machine merely for philosophical experiments, or for the purpose of ascertaining the sufficiency of the machine to produce its described effects".

[55] In Madley it was observed that although universities like Duke fund projects with no commercial application, but such projects "unmistakably further the institution's legitimate business objectives, including educating and enlightening students and faculty participating in these projects".

The judgment also stated that:

"In short, regardless of whether a particular institution or entity is engaged in an endeavor for commercial gain, so long as the act is in furtherance of the alleged infringer's legitimate business and is not solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry, the act does not qualify for the very narrow and strictly limited experimental use defense".

[56] See Colin Macilwain, Berkeley Teams Up with Novartis in $ 50m Plant Genomics Deal, Nature, Nov. 5, 1998 See Dueker, Kenneth Sutherlin (1997), Kenney, Martin (1988),. Press, Eyal, Washburn, Jennifer (2000), Krimsky (2003) See also Bok (2003).

[57] Derzko (2004) gives an analysis of research exemption in Europe. See also Hoffman, David. C (2004).

[58] Refer to the discussion in the chapter on seeds and plant varieties and the citations therein.

[59] " ... access to Monsanto's(Pharmacia) rice genome sequence database has multiple restrictions, such as it is limited to publicy funded research at non-profit research organizations and government research agencies, data downloads are limited to the amount of data submitted up to 26 kb per request (thereby severely curtailing the applications or research possible with these data)., any resulting intellectual property, although vesting with the institution , must be reported to Pharmacia along with a copy of patent filing. Furthermore the institution must grant Pharmacia a right to negotiate a non-

exclusive license and agree that Pharmacia may use the research results in its internal programs" Nottenburg (2001) P. 20.

See also Binenbaum (2003)

[60] See Seedling Oct 2002 http://www.grain.org/seedling/?id=207

Also the discussion in Ravi Srinivas, K. (2003)

[61] Kowalski S.P, Ebora R.V. Kryder R.D. Potter R.H. (2002)

[62] Kryder, R.D., Kowalski, S.P. and Krattinger, A.F. (2000)

[63] Lorch, A. (2001)

[64] "Nevertheless the implementation of TRIPS will affect the freedom to operate in the next generation of biotechnology. Guiding these changes in intellectual property regimes and responding creatively to the new environment are pressing challenges for those interested in the future of scientific research, including agricultural biotechnology". Nottenburg, Carol, Pardey, P.G, Wright, B.D (2001)