Software IPR Valuation Model

By Dr. Santosh Mohanty and Kaushik Gala

Abstract

The hyper-connected world we live in is fundamentally altering our lives. Digital technologies are challenging long-held norms. Inventions and their related intellectual property rights (IPR) are crucial for enterprises to differentiate themselves in a highly competitive global market. Software enterprises, in particular, are at risk of rapid obsolescence unless they capture, protect and leverage their innovation ecosystem and IPR portfolio.

Intellectual property (IP) is hotly contested in an industry that innovates fast and where technological and design advantages can result in large opportunities. New companies have emerged whose sole activity is to create and lease IP. There are companies that disrupted the business models and displaced the titans. Whereas few others have achieved the zenith and then disappeared from the scene as a result of market dynamics.

Software inventions are inherently different from those in physical sciences, hardware, and such. Evaluating them requires a novel approach, given the variety of ways in which software intellectual property can be developed, protected, regulated, productized, monetized and infringed. Traditional approaches to IPR valuation such as market-based, cost-based and income-based may be irrelevant or cumbersome, given the dynamic nature of the software industry. Software IPR valuation is highly contextual and hence, providing relevant input for traditional valuation models becomes prohibitively time-consuming, especially for valuation exercises at a portfolio level. Digital transformation of all industries makes software IPR exponentially more valuable.

To enable global enterprises to quickly and systematically evaluate their software IP, we introduce a model called Invention Valuation and Scoring System (IVSS). The model relies on two primary dimensions:

1. ***Sustainability*** *"S" of an invention i.e. how futuristic, agile, resource-efficient and adaptable is the software by design; and*

2. ***Commercial Viability*** *"C" of an invention i.e. how well it can be operationalized, made relevant to customers, and profitably delivered to a large/fast-growing market.*

Each dimension has four attributes, thus resulting in a "4Sx4C" matrix with 16 cells, each cell of which can be assigned a value. Since this model is to be used by a commercial enterprise driven by profit/revenue growth targets and shareholder value creation, the 16 cell values are, in turn, linked to business outcomes e.g. strategy, defensibility, market coverage, and customer value. These 16 weighted values, along with simple inputs related to commercial pricing, then result in a systematic valuation of the invention, while accounting for changes in the estimated valuation over a period of time.

The IVSS model thus provides a systematic, techno-commercial methodology to evaluate a portfolio of software IPR assets, in the context of enterprise software IPR management. We illustrate a specific use-case of IVSS to evaluate software IPR related to a mobile-first agricultural services delivery platform for rural farmers in India.

Introduction

A patented invention requires novel, inventive steps towards technical and process advancements, as well as, utility for commercialization. Such inventions usually constitute the IP assets of software enterprises. While mining and protecting such inventions, IP managers seek to determine the tangible value attached to each intangible asset, so as to enable the enterprise's decision on creating, maintaining and monetizing IPR assets. Significant challenges exist for efficient and effective valuation of software inventions. These include rapid technology change and obsolescence, new go-to-market models, globalization of software creation and use, dynamic pricing strategies enabled by software, ease of infringement and theft of software IP, uncertainty in regulatory protection for software IP, *etc*.

Software IP can be formally protected via Copyrights, Trademarks, Patents, Industrial Designs, *etc.* From an enterprise perspective, each invention is an IP asset only if the value it delivers exceeds its associated costs. Thus, each invention must be evaluated throughout its life cycle viz., from ideation to patent drafting to territorial protections, and finally commercialization and patent maintenance. Since IPR such as patents have a defined expiration date, the valuation model must also account for changes over time. Each invention should ideally be evaluated against others within the portfolio, so as to support managerial decisions on IPR maintenance, go-to-market strategy (*e.g.*, *product licensing vs. IP licensing vs. IP sale)*, *etc.* Finally, an ideal IP valuation model should be comprehensive, systematic, quick, and intuitive; it should require minimal, simple human inputs.

Traditional Models of IP Valuation

Three common approaches to IP valuation[i] have traditionally been: cost-based, market-based and income-based.

Each approach requires a set of inputs based on past experience and expert judgment. For example, the cost-based approach requires the evaluator to assess what a similar IP asset might cost to develop or acquire. The market-approach requires the value at which similar IP assets have been recently sold in the market. The income-approach requires an estimate of future cash flows from monetization of the asset, and a discount rate to compute the net present value.

These approaches are, of course, subject to errors due to incorrect inputs, lack of availability of relevant data, human biases, insufficient expertise on part of the evaluator, incorrect definition of the IP asset, *etc*. Given the commercial sensitivity of IP assets, publicly-available data is often limited or less reliable. Moreover, since there are numerous ways to commercialize an IP asset, its value is intricately tied to the context in which it is marketed. Qualitative methods are also sometimes used for patent valuations. These rely on attributes such as number of independent claims, number of forward citations, age of the patent, geographic coverage, breadth of portfolio, *etc*. However, such methods remain peripheral in counting business and market factors, and remain exposed to human biases.

Despite these limitations, IP managers continue to use, and refine, the above methods to compute IP valuations, usually by triaging the valuation estimates[ii] made using independent methods, and explicitly noting the assumptions in the model. The importance of context[iii] has become apparent—the value of a patent may differ by orders of magnitude depending on whether it's being sold, licensed, infringed, contributed to a standards pool, or found to be invalid. Needless to say, there are numerous alternative models[iv] being used that account for factors such as brand, liquidation value, auction value, real options value, *etc*. In fact, IP valuation is further challenged by the fact that it may be done as part of in-kind arrangements, fire sales, academic collaborations, *etc*.[v]—these in turn require valuation inputs and models different from typical licensing/sales. Given that a majority of patents expire without a worth, while a small fraction are worth millions,[vi] a robust need exists for patent buy/sell transaction data as a reliable input to IP valuation models.

Software IP Valuation

Valuation of software IP offers an entirely new challenge, given the variety of ways in which software inventions can be created, protected, monetized and its enforcement through contracts. Income-based valuation models seem to be more relevant[vii] given the intangible nature of software IP and the non-linear value creation possibility via network effects, "winner-take-all" effects and the likes. The difficulty in enforcement of software IP rights greatly affect its valuation.[viii] Furthermore, the choice of market and path to market can lead to substantially different "realized" values[ix] of software IP (*e.g.*, *Pets.com vs. Amazon.com)*. It has also been argued[x] that software IP can serve as a tax by larger companies on smaller companies.

■ Dr. Santosh Mohanty, Tata Consultancy Services Limited, Vice President and Head Component Engineering Group, Mumbai, India
E-mail: santosh.mohanty@tcs.com

■ Kaushik Gala, Tata Consultancy Services Limited, Manager, IP Ecosystem Strategy Mumbai, India
E-mail: k.gala@tcs.com

IVSS Model

In a B2B software enterprise, the IP assets and IPR that are developed are usually consumed by the products, platforms and solutions that are offered to customers. This implies that the IP valuation model used by such enterprises accounts for the wide variety of IP assets (from snippets of code to standalone products to large software platforms) in the portfolio. Moreover, the volume of IP assets and IPR expected to be created in a large software business necessitates a systematic approach to IP valuation. In fact, an enterprise that offers both software services and software products requires a sharp distinction between its IP assets and those of its customers. This boundary can keep changing over time and based on the nature of customer engagements.

The above requirements, unique to software IP, led us to refine an earlier, proprietary model[xi] for invention valuation and rationalization that accounts for both technical and commercial aspects, their dynamic nature, and the mapping of IPR to business outcomes.

Sustainability "S" Attributes:

Our model seeks to evaluate each software IP on four dimensions, related to its innovativeness and sustenance of the corresponding competitive advantage. These are as follows:

1. "**Anticipative**"—does the invention anticipate future needs of market, technology, *etc.* and create 'novelty' at the present time to address it? Will it sustain despite the changing nature of market forces?

2. "**Agile**"—can the "inventive steps" in the invention sense the current needs and provide a responsive solution, via a fast track process to transform the IP into products or service offerings?

3. "**Efficient**"—will the invention, when reduced to practice, allow "doing more with less" in terms of lower cost, minimum infrastructural modification,

time reduction, better quality, less effort, *etc.*?

4. "**Adaptable**"—is the invention flexible and resilience to change, *i.e.*, are the inventive steps applicable, with minimal change, to similar scenarios or problems? Does it balance personalization with mechanization?

Commercializability "C" Attributes:

Our model also seeks to evaluate each software IP on four other, orthogonal dimensions, related to its operational and marketable strength as an asset. These are as follows:

1. "**Technology**"—does the invention utilize or create state-of-the-art technology, and its associated processes and on-demand, elastic infrastructure, to deliver maximum customer value?

2. "**Context**"—does the invention leverage the enterprise's contextual knowledge of customers, industry players, business domain, white spaces and market dynamics?

3. "**GTM**"—does the invention enable new, disruptive go-to-market (GTM) strategies, scaling, distribution channels or revenue models for the enterprise?

4. "**Outcome**"—will the invention have a meaningfully positive outcome for the business and its stakeholders?

The first three attributes are "lead" attributes in the sense that these capabilities are pre-requisites for the IP to be monetized. The fourth attribute is a "lag" measure of the invention's impact. Also, the technology and the associated rate of change is becoming key for a software enterprise to grow sustainability—much more than process or infrastructure. Being able to deliver context-specific value to the customer, and take inventions to market is the key to success in this digital age of mass customization.

4Sx4C Matrix:

We capture these 4 "S" and 4 "C" attributes of each invention via a 4x4 matrix, as below in Table 1:

Weighted 4Sx4C Matrix:

Table 1

Table	Outcome	GTM	Context	Technology
Anticipative				
Agile				
Efficient				
Adaptable				

As a commercial enterprise, the business outcomes of an IP asset or IPR are most critical in the valuation. Also, given the incredibly dynamic nature of the software industry, and the ease of "bypassing" software IPR, we seek to give greater emphasis on the "anticipative" aspects of invention and the realization of "outcome." Hence, we choose to weight the 16 cells in the above 4x4 matrix as follows:

- Base weight of "1" for each cell
- Double the base weight for the cells under "Outcome" column or "Anticipative" row (Hence, the base weight of the cell under "Outcome" column and 'Anticipative' row is multiplied by a factor of "4")

The Weight Table is presented below as Table 2: *Note that the total weight across the 16 cells is 25.*

Table 2

Weight (W) Table	Outcome	GTM	Context	Technology
Anticipative	W:4	W:2	W:2	W:2
Agile	W:2	W:1	W:1	W:1
Efficient	W:2	W:1	W:1	W:1
Adaptable	W:2	W:1	W:1	W:1

Inventions in a software enterprise are driven by a current or anticipated business opportunity. Inventors are aligned with requirements from development teams, inputs from sales and marketing teams, and the need of the customers. Each patentable/patented invention is hence expected to have the following characteristics:

a) Align to business strategy, operations and initiatives ("**Aligned**")—at a granular level, can the patent be mapped to specific products that the enterprise intends to sell, leveraging its market and customer discovery efforts?

b) Be difficult for other industry players to reproduce ("**Unique**") quickly—is the invention incremental (and hence likely to be imitated easily) or disruptive (and hence, difficult to reproduce)?

c) Cover a broad and rapidly growing customer base, across geographies ("**Broad**")—is the total/addressable market and target market share large enough in the context of the enterprise's revenue and profit goals? Will the invention enable broad market coverage, despite the varying ability and willingness of different countries to enforce patent protections?

d) Drive value creation, and thus strengthen enterprise brand, in the mind of the customer ("**Valuable**")—does the invention enable a competitive moat, as demonstrated in value to the customer, that helps maintain/boost profit margins?

These four factors can then be added to the 4Sx4C matrix to evaluate a particular invention. While all the four characteristics are associated with each cell in the 16-cell matrix, we have identified the most influencing characteristic associated with each cell in the 4Sx4C matrix. This is especially true as we focus on enterprise software inventions, and seek to promote the IVSS model amongst a large number of users/inventors, each of whom is expected to provide inputs to the valuation model. We have mapped the relevant characteristic to each cell, as shown in Table 3.

These questions help provide a Boolean (*i.e.* 0 or 1) value for the relevant characteristics (Aligned/Unique/Broad/Valuable) for a particular cell.

Thus, an invention's score is computed in two steps as follows:

i. Determining the weighted score of each cell by multiplying the respective characteristic's Boolean value with the cell weight; and

ii. Computing the total score by adding the weighted scores of all 16 cells.

Note that the maximum *Invention Score* (IS) for any particular invention is 25—while the minimum can be zero.

Each invention in an IPR portfolio can thus be individually scored by inventors and IP managers. They only need to provide a set of 16 Boolean inputs, based on the relevant degree of product, domain and customer insights. It can be argued that absent these insights, it wouldn't be possible for inventors to develop a patentable invention anyways! The next step is to convert the IS into a numerical valuation estimate.

Table 3

IVSS Table	Outcome	GTM	Context	Technology
Anticipative	**Broad:** Will the invention enable us to target anchor customers in new, high-growth markets?	**Unique:** Will the invention lead to competitively advantageous GTM strategies?	**Valuable:** Does the invention use our customer insights to anticipate future, unmet needs?	**Aligned:** Does the invention leverage our technology investments and human capital?
Agile	**Aligned:** Will the invention allow us to rapidly capture market share in high-growth lines of business?	Valuable: Does the invention allow us to quickly scale our marketing and sales?	**Unique:** Will the invention help us gain new customer insights, not easily available to other industry players?	**Broad:** Will the invention enable us to compete despite/because-of rapidly evolving technologies?
Efficient	**Unique:** Will the invention enable us to improve and sustain higher profit margins, and avoid commoditization?	**Aligned:** Does the invention introduce operational efficiencies in marketing and sales?	**Broad:** Can the invention cater to both price-conscious and premium customers?	**Valuable:** Does the invention leverage/create technology to offer a compelling value proposition?
Adaptable	**Valuable:** Does the invention allow us to mass-customize our offerings?	**Broad:** Does the invention enable us to market and sell to a wider variety of customers?	**Aligned:** Will the invention easily evolve with changing customer requirements?	**Unique:** Will the invention allow us to serve customers that other industry players cannot?

Table 4

IVSS Table	Outcome	GTM	Context	Technology
Anticipative	**Broad (0/1) * W:4**	**Unique (0/1) * W:2**	**Valuable (0/1) * W:2**	**Aligned (0/1) * W:2**
Agile	**Aligned (0/1) * W:2**	Valuable (0/1) * W:1	**Unique (0/1) * W:1**	**Broad (0/1) * W:1**
Efficient	**Unique (0/1) * W:2**	**Aligned (0/1) * W:1**	**Broad (0/1) * W:1**	**Valuable (0/1) * W:1**
Adaptable	**Valuable (0/1) * W:2**	**Broad (0/1) * W:1**	**Aligned (0/1) * W:1**	**Unique (0/1) * W:1**

Initial and Time-dependent Valuation:

B2B enterprises, by definition, market their software products, platforms and solutions to business users, not (mass market) consumers. Commercial implementation of inventions are thus expected to be consumed by users such as corporate employees, middle management, executives, CXOs, *etc*. Thus, invention creation in an enterprise is usually contextual, driven by a business case, with a reasonable idea of the target customer and the corresponding product or platform or solution that will consume the invention. As software gets more consumerized and personalized, B2B enterprises have to act in B2B2C mode, by anticipating and adapting to the needs of the consumers. In fact, the border between pure B2B and pure B2C will continue to thin out, as digital technologies will transform the consumption pattern.

Thus, a ballpark estimate can be made in many cases by the product management on

- Sale price per an unique user, called *Value per Unit Sale* (VUS).
- Number of annual "sales" expected in steady state, in-line with annual revenue targeted in the business case, called *Number of Unit Sales* (NUS).

VUS is expected to be in the currency relevant to the target market (US$, by default.) This can be converted to another currency using an adjustment factor such as the *Purchasing Power Index* (PPI).

Furthermore, each invention either may be contributed by a team of inventors associated with a software development team or may get attributed to a software as a part of periodic patent-product mapping exercise to mine enterprise's invention portfolio.

We thus introduce the *Contribution-Attribution Factor* (CAF) that is simply a function of the total number of inventions associated with the same software as the one targeted by a given invention, computed as follows:

$$CAF = 1 / \text{Total relevant inventions}$$

The CAF calculation thus nudges the product manager to consciously search the enterprise patent portfolio for relevant patents, thus broadening the product's IP footprint. This is driven systematically by a *collaborative invention mining* (CIM) strategy[xii] intended to unearth related inventions from within the existing portfolio. In fact, the Digital IP Genome set[xii] allows rapid portfolio mining, using claim elements as the core search criteria. This is crucial in a large enterprise where inventors across multiple R&D labs, business units, operations and infrastructure groups create IPR assets whose claims happen to cover same invention subject areas.

Finally, we account for the fact that IP rights contribute only a certain fraction to the overall commercial offering. One proxy for this is the royalty rates that an IP license can command, if the invention was licensed to another enterprise, which then productizes and commercializes the invention. Based on our professional knowledge, we have estimated *royalty rate, if licensed* (RRIL) in the context of a variety of software offerings that include Components; Frameworks; Proof-of-Concept, Proof-of-Technology, and Demos; Products; Platforms; and Solutions. We use this factor (RRIL) to further modulate the invention valuation. RRIL can vary from 0.5 percent to 20 percent.

We are now able to compute initial (base) valuation of each invention as a function of the market it targets (via revenue estimates of the corresponding product), and the degree of its contribution and/or attribution to a commercial outcome.

Base Valuation

The *Base Valuation of an Invention* (BVI) is defined as its value on the first year and computed as follows:

$$BVI = NUS * VUS * CAF * RRIL$$

Alternate Base Valuation

Alternatively, there may be cases where either the inventor has reasonably good benchmark data for the value of similar inventions or the invention is of "fundamental" nature and not yet mapped to a specific product. In such cases, the IVSS model allows the inventor to directly provide an initial estimate of BVI. Over time, as the invention is mapped to a commercial offering, the BVI will be revised using the formula developed above.

Valuation Over Time

The valuation of software IP assets and IPR will necessarily change over time, given the inherently dynamic nature of technology, industry and market. Rapid commoditization of software technology, combined with exponential pace of innovation, implies that the value of the majority of software inventions may drastically reduce in a relatively short time span. Digital transformation, of and via software, introduces significant variations in how fast, or slow, a given invention will lose its differentiator to commercial success.

We seek to model this by computing a time-dependent invention valuation (IV) as follows:

$$IV(t) = (BVI)^{[(\alpha\left(\frac{IS}{N}\right))^{(t-1)}]}$$

Wherein, "t" is the year, N is the maximum possible Invention Score (IS) (*i.e.* 25) and α is defined as a "smoothing parameter" ($\geq\alpha\geq 1$). The "smoothing parameter" α depends on t and is driven by factors such as changes in technology, target market growth, competitive intensity, life cycle of the invention, creation of adjacent inventions, change in business strategy, *etc*. By default, $\alpha = 1$.

Note that the valuation of an invention in the first year equates to BVI itself, *i.e. IV(1)=BVI*. If the calculated shelf-life for a patent is "t~," then IV (t~) > 0.1 percent * IV (0).

***Lifetime Valuation of an Invention* (LVI):**

We compute the Lifetime Valuation of the Invention (LVI) as a sum of its yearly valuations over a specified period "n":

$$LVI = \sum_{t=1}^{n} (BVI)^{[(\alpha(\frac{IS}{N}))^{(t-1)}]}$$

Wherein n=20 by default, since the lifetime of a patent is ~20 years, ignoring patent term adjustments across jurisdictions and starting the time period from the date of filing of the Complete Specification. LVI estimates the total revenue that an invention might generate over its life-cycle.

Example: Patented Agro Service Delivery Platform

Multiple inventions were developed and protected as part of the creation of a personalized, mobile-first, agricultural services delivery platform[xiii] for rural farmers across India. It is also applicable for fisheries and cattle management. Services delivered over the platform include site-specific agro advisory, pest control, best practices, food grain price alerts, weather forecasts, farm produce procurement, local language training, information about loans, *etc*. One such invention is Indian *Patent No. 271147*—"A mobile-based advisory system."[xiv]

We illustrate the valuation exercise for this invention by scoring it as shown in Table 5.

Thus, the weighted *Invention Score* (IS) works out to 16.

We then convert the IS to a numerical base valuation estimate, with these inputs:

- Sale price per an unique user *i.e. Value per Unit Sale* (VUS) = INR 1000 subscription per year
- Number of annual "sales" expected in steady state[xv] *i.e. Number of Unit Sales* (NUS) = 50,000
- CAF = 1/11 (there are eleven inventions that contribute to this commercial offering)
- RRIL = 7.5 percent

Thus, BVI = VUS * NUS * CAF * RRIL ~ INR 340,000.

The illustration can also be extended to compute a lifetime valuation estimate, using:

$$LVI = \sum_{t=1}^{n} (BVI)^{[(\alpha(\frac{IS}{N}))^{(t-1)}]}$$

For α =1.5, and n=20, the LVI works out to ~ INR 900,000.

Summary

The rise of software-driven enterprises highlights the increasing importance of software IP and IPR (particularly patents) for sustainable growth. As they engage in continuous software innovation, global technology businesses need to systematically evaluate their software IP. A portfolio-wide estimate of the market value of software IP assets is key to strategic R&D investments, IP filings and go-to-market initiatives.

To support this, we introduce a model called *Invention Valuation and Scoring System* (IVSS) for comprehensive valuation of software IPR by business managers. The model first captures sustainability and commercial viability aspects of an invention in a "4Sx4C" matrix with 16 cells. Each cell is then assigned a Boolean value, linked to business outcomes *e.g.* strategy, defensibility, market coverage, and customer value. These 16 weighted values, along with simple inputs related to commercial pricing, enable systematic valuation of an invention, while accounting for changes in the estimated valuation over a period of time. We have the illustration of IVSS through a patent in a subject area of "mobile-first agricultural services delivery platform for rural farmers."

Table 5

IVSS Table	Outcome	GTM	Context	Technology
Anticipative	**Broad (1)** * **W:4**	**Unique (1)** * **W:2**	**Valuable (1)** * **W:2**	**Aligned (1)** * **W:2**
Agile	**Aligned (0)** * **W:2**	Valuable (0) * W:1	**Unique (0)** * **W:1**	**Broad (1)** * **W:1**
Efficient	**Unique (0)** * **W:2**	**Aligned (0)** * **W:1**	**Broad (1)** * **W:1**	**Valuable (1)** * **W:1**
Adaptable	**Valuable (1)** * **W:2**	**Broad (0)** * **W:1**	**Aligned (1)** * **W:1**	**Unique (0)** * **W:1**

We intend to further refine the model over time, with finer estimates of inputs such as royalty rates, historical estimates of the smoothing parameter "α", and development of similar models for software and other IP assets. ■

References

i. "Methods of Intellectual Property Valuation," *Darden*, University of Virginia, (2000).

- *https://faculty.darden.virginia.edu/chaplinskys/PEPortal/Documents/IP%20Valuation%20F-1401%20_watermark_.pdf*.

ii.. "IP Valuation, Exploitation and Finance," WIPO-PwC Workshop, (2011).

- *http://www.wipo.int/edocs/mdocs/sme/en/wipo_smes_tlv_11/wipo_smes_tlv_11_ref_t15.pdf*.

iii. "Final Report from the Expert Group on Intellectual Property Valuation," European Commission, (2013).

- *https://ec.europa.eu/research/innovation-union/pdf/Expert_Group_Report_on_Intellectual_Property_Valuation_IP_web_2.pdf.*

iv. Weston Anson, "Alternate Approaches to the Valuation of Intellectual Property," *IP Watchdog*, (2015).

- *http://www.ipwatchdog.com/2015/02/11/alternate-approaches-to-the-valuation-of-intellectual-property/id=54651*.

v. "A Practical Guide for Valuing Intangible Assets in Research and Development Institutions," *WIPO*, (2016).

- *http://www.wipo.int/edocs/mdocs/mdocs/en/cdip_17/cdip_17_inf_2.pdf.*

vi. Hayes & Soloway, "Patent Valuation," (2016).

- *http://www.hayes-soloway.com/patent-valuation.*

vii. Gio Wiederhold, "What is Your Software Worth?," Stanford University, (2007).

- *http://ilpubs.stanford.edu:8090/862/1/worth43.pdf*.

viii. Susanna Hult, "Valuation of Intellectual Properties," KTH, Sweden, (2012).

- *https://www.nada.kth.se/utbildning/grukth/exjobb/rapportlistor/2012/rapporter12/hult_susanna_12060.pdf*.

ix. "State of Practice in Software Valuation," Intellectual Asset Management, 2013.

- *http://www.iam-media.com/Magazine/Issue/59/Features/State-of-practice-in-software-valuation*.

x. Colleen Chien, "The Market for Software Innovation Through the Lens of Patent Licenses and Sales," Santa Clara University School of Law, 2017.

- *http://digitalcommons.law.scu.edu/facpubs/943*.

xi. Santosh Kumar Mohanty, "Invention Valuation and Scoring System," *US20130166459A1*, Tata Consultancy Services Limited, (2013).

- *https://www.google.com/patents/US20130166459*.

xii. Santosh Kumar Mohanty, "Managing Sustainable Intellectual Property Portfolio of an Enterprise," *US9633403B2*, Tata Consultancy Services Limited, (2013).

- *https://www.google.com/patents/US9633403*

XIII. "mKRISHI—Connecting India's Rural Farmers," TCS Innovation Labs, (Mumbai, 2017).

- *https://www.tcs.com/mkrishi-connecting-india-rural-farmers.*

XIV. "A Mobile-based Advisory System," Indian *Patent No. 271147*, Tata Consultancy Services, 2016.

- *http://www.allindianpatents.com/patents/271147-a-mobile-based-advilsory-system.*

xv. "Evolution of mKRISHI®: A Technology Platform for Indian Farmers," Business Innovation Facility, 2013.

- *http://www.inclusivebusinesshub.org/wp-content/uploads/2016/05/Deepdive_mKRISHI_HUB-14.pdf.*

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=3009919*