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IP Management in the Context of Developing Countries – The Case of Iran's Industrial Companies

Developing countries are different from developed countries in terms of their industrial structure, and they face more challenges in their efforts to develop technology. Since developing countries such as Iran do not usually develop technologies they need by themselves, there is not enough motivation among producers to apply intellectual property rights. In this paper, after a comprehensive look at the relevant literature in the field of IP in Iran, a conceptual model, including decision variables for effectiveness in applying IP, will be proposed. Based on this classification, research and development capabilities, technological capabilities and environmental variables have been selected as decision variables. We then analyze the results of a survey of 180 manufacturing companies in the largest industrial park in Iran, based on work experience, fields of activity, and the number of human resources. The results show that the motivation of the studied companies in applying IP is poor and that there is more motivation in electrical groups and large-sized factories. Moreover, the highest correlation between the factors involved in not applying IP is the companies' lack of internal research and development capability. Research and development required for adapting the technology with the internal conditions, the importance of education and training for acquiring the technological capability, support for research and development, and the importance of intellectual property rights are four important areas that should be focused on by technology strategy in Iranian industrial companies.

I. Introduction

The existing literature on intellectual property (IP) in the context of developing countries mostly deals with IP law and enforcement as well as IP awareness as compared to widely accepted norms and standards. The same general rule, to a great extent, applies to prior IP studies in Iran, since the limited number of papers published in the field only deal with Iran's IP laws and regulations and the evolution thereof. These papers clearly indicate that

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Iran's IP law has improved dramatically during the last decade. Considering this major upgrade of the country's IP law, one may wonder if there has been any change in the Iranian firms' approach to IP, that is, do Iranian companies regard IP as an effective means of value creation and capture? Do they manage their IP to acquire and maintain a competitive advantage in the market? Trying to answer the above questions, we investigated the attitude of Iranian small and medium-sized manufacturing companies toward IP and IP management in more detail. To this end, we quantitatively surveyed a sample of 180 manufacturing firms active in the industrial parks of Qazvin Province. The share of small and medium manufacturing companies of all manufacturing industries in Iran during the second, third, and fourth development programs (1995–2010) (see Table 2 below) was more than 80%, which makes the study essential in this area. In Table 1 Iranian companies in the manufacturing industries during the fourth development program are listed by size and number of companies, number of employees, production value, and value added. According to Table 1, in 2009 the proportion of small and medium-sized companies in terms of the number of firms in the industry was 87%; and in terms of number of employees, they made up 36% of the sector. However, the share of big companies in terms of production value and value added reached 85% in this period.

Table 1 – Share of Iranian Production Sector in Employment and Value Added

Size of Company	Number of Companies	Number of Empolyees	Percentage of Production Value	Percentage of Value Added
Small	11,337	251,296	10.1	9.1
Medium	1,781	120,644	6.3	5.7
Large	1,946	371,940	87.7	85.2
Total	15,064	1,030,700	100	100

Source: Iran Statistic Center, Annual Report 2010

Small: fewer than 50 employees, Medium: 50 to 100 employees, Large: more than 100 employees

In this paper, we first briefly review the shift of Iran's IP landscape. The locus of our review is the country's patent law and its evolution over time. Then we look into the existing literature on IP management at firm level in developing countries. Next, our research methodology is introduced. Research results and their analysis are discussed. The paper concludes with the policy implications of the research findings.

II. IP Management in Developed and Developing Countries

Developing countries differ from developed countries in terms of industrial structure. In their efforts to develop technology they also face more chal-

lenges than do developed countries. Since developing countries, including Iran, do not usually develop new technology by themselves, there is insufficient incentive among manufacturers for protecting intellectual property rights (IPRs). However, the question is whether this reluctance is due to lack of innovativeness on the part of manufacturing companies or other factors. To the best of our knowledge there is not yet any research available that investigates this in the context of developing countries. The global trend towards stronger IPRs that has taken place in the past two decades has progressed in different dimensions.[1] Protection has extended from invention to discovery; from mechanical devices to living organisms;[2] from privately funded research and development to publicly funded scientific and technological results; from information about technology to information about scientific information;[3] from industrial products and technological processes to services and financial and administrative methods.[4] Appropriability of innovation for the innovative companies is essential because it enables them to benefit from the profitability of achieving innovation in the market. The importance of appropriability is mentioned by Harabi in his studies.[5] The only firms that are highly probable to protect the benefits from their innovation are those that have enough motivation to develop their innovation and inventions. Ability to protect innovation is the strategic success factor for the company that wants to have exclusive benefits from its research and development.[6] An appropriate and effective protective system will allow companies to benefit from their innovations.[7]

Developing countries' policies and academic debate on IP have followed a pendulum-like movement. Soon after the Second World War, a new perspective on the importance of technology in trade and development was created by the work of United Nations programs (such as the Economic Commission for Latin America) and independent economists from developing countries. These analyses, which centered on technology transfer issues, concluded that

1 C. Forero-Pineda, "The impact of stronger intellectual property rights on science and technology in developing countries", 35 Research Policy 808 (2006).

2 M. Bystrom, P. Einarsson & G. Nycander, "Fair and Equitable: Sharing the Benefits from Use of Genetic Resources and Traditional Knowledge", Swedish Scientific Council on Biological Diversity, 12, at 39–445 (1999).

3 P.A. David, "Tragedy of the Public Knowledge 'Commons'?: Global Science, Intellectual Property and the Digital Technology Boomerang", Electronic Journal of Intellectual Property Rights (2000).

4 J. Lerner, "Where Does State Street Lead? A First Look at Finance Patents", 1971–2000, National Bureau of Economic Research, NBER Working Paper Series, No 7918 (2000).

5 N. Harabi, "Appropriability of technical innovations: an empirical Analysis", 24(2) Research Policy 981 (1995).

6 K. Brockhoff, "Exploring strategic R&D success factors", 15(3) Technology Analysis and Strategic Management 333 (2003).

7 P. Hurmelinna, K. Kylaheiko & T. Jauhiainen, "The Janus face of the appropriability regime in the protection of innovations: Theoretical re-appraisal and empirical analysis", 21(2) Technovation 180 (2007).

developed and developing countries should take a different stance concerning the protection of IP. They often stressed that situations of monopoly and oligopoly in world technology markets prevented developing countries from having fair access to technology.[8] Until recently, IPRs have had little importance in developing countries, because there seems to have been little research and development in these countries with the ability to create valuable trade marks. But from the late 1980s onward, the World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which was adopted widely by developed countries, forced developing countries to use IPRs based on the patent system.

III. Iran's IP landscape

The first Iranian "patent and trademark" laws date back to 1924.[9] Since then, the IP landscape of the country has witnessed many improvements, the main drivers of which are believed to be the national policies aimed at encouraging the development of knowledge-based products and commercialization of research results. Accordingly, these policies view the IP system largely through the lens of incentive function.[10] The growing attention paid to improving the country's IP system can be well seen in Iran's Economic, Social, and Cultural Development Plans. These plans usually define the macro-economic directions of the country for five-year periods. Table 2 clearly shows the growing concerns of policy-makers with the role of the IP system in national development.[11]

Table 2 – IP Consideration in Iran's Development Plans (1990–2009)

Plans	**The degree of considering IPR in the documents of the plan**	**Clarity of special policies and strategies for improving the IPR system in the documents of the plan**
First Plan (1990–1994)	None	No specific policy strategy
Second Plan (1995–1999)	None	No specific policy or strategy

8 M. Cruz, "History of the Industrial Property Strategies and Transfer of Technology Administrative System in Brazil", (1998) Universidade Estacio de Sa, available at: http:// www.estacio.br/categorias/cursos/mestrado/mestrado/adm/artigos/hi. htm.

9 M. Rezapour, S.K. Bagheri, M. Rashtchi & M.R. Bakhtiari, "The Iranian patenting system: an introduction", 29 World Patent Information 250 (2007).

10 A. Sarkissian, "Intellectual property rights for developing countries: Lessons from Iran", Technovation (2008), doi: 10.1016/ j.technovation.2008. 04. 001.

11 M. Goodarzi & S.K. Bagheri, "IP system in Iran: a comparative study", in: "Proceedings of the Portland international conference management of engineering and technology", 8–13 (Istanbul, Turkey 2006).

Third Plan (2000–2004)	Reference to the defects in Iran's IPR regime and the necessity of solving the problems	No specific policy or strategy
Fourth Plan (2005–2009)	Clear reference to the existence of many defects in Iran's IPR regime and the necessity of removing them during the execution years	Obliged the government to plan and implement a comprehensive IPR system

The mentioned policies, in addition to increasing IP awareness in the country, have led to a series of legislative changes in support of a general trend toward a stronger IP system.[12] A brief history of IP-related legislative changes is shown in Table 3.

Table 3 – IP-Related Legislation History of Iran[13]

1924	Patent and Trademark Act
1930	Parliamentary permission to exchange "patents, industrial and trademark, trade names, industrial designs and industrial and literary rights protection agreement between Iran and Germany"
1931	Patent and Trademark Registration Act.
1933	Trade Law
1970	Act for the Protection of Authors', Composers' and Artists' Rights
1973	Act for Translation and Reproduction of Books, Periodicals and Audio Works
2000	Protection of Computer Software Creators' Rights Act
2003	Electronic Commerce Act
2004	Ministry of Science, Research and Technology (MSRT) established, Objectives and Functions Act
2005	Protection of Geographical Indications Act
2008	Patents, Industrial Designs, Trademarks and Trade Names Registration Act

The country's patent system has accordingly experienced similar changes and improved in many aspects. The major characteristics of the patent system as well as its landmark changes are reflected in Table 4.

12 S.K. Bagheri, H.A. Moradpour & M. Rezapour, "The Iranian patent reform", 2009 World Patent Information 31, 32.

13 A. Sarkissian, "Intellectual property rights for developing countries: Lessons from Iran", Technovation (2008), doi:10.1016/ j.technovation.2008.04.001.

Table 4 – Evolution of Iranian Patent Law[14]

The first patent law	Patent and Trademark Registration Act, 1924
Shift to "first to file" rule	From the beginning
First attempt to clarify the invention requirements	Patents, Industrial Designs, Trademarks and Trade Names Registration Act, 2008
Patentability of software	Registration and Protection of Computer Software Act, 2001
Introduction of microbiology patents	Not yet
Responsibility for the Patent Office	Judiciary From the beginning
Grace period	6 months (as of 2008)
Addition of "non-obviousness" requirement	Patents, Industrial Designs, Trademarks and Trade Names Registration Act, 2008
Adoption of the doctrine of equivalents	Not yet
Terms of protection	Up to 20 years From the beginning
Accession to the Paris Convention	December 16, 1959
Accession to the Patent Cooperation Treaty (PCT)	Not yet (although approved by the parliament years ago)

Considering the major upgrade that has taken place in the country's IP law, one may wonder if there has been any change in the Iranian firms' approach to IP. In other words, do Iranian firms regard IP as an effective means of value creation and capture? Do they manage their IPs so as to acquire and maintain a competitive advantage in the market?

IV. A Few Cases of IP Survey Research in Different Countries

Practically all empirical studies indicate that small and medium-sized firms do not use IPRs in the same way as larger firms. The contribution of small and medium-sized enterprises (SME) to innovation, technological progress, and economic growth in the US has been well documented. Small firms also have higher patenting rates than larger ones when measured on a per-employee basis.[15, 16] In contrast, larger firms produce more patents per firm.

14 S.S. Ghazinoory, M. Abdi & S.K. Bagheri, "Promoting nanotechnology patenting: A new experience in the National Innovation System of Iran", 12 Journal of Intellectual Property Rights 464 (2010).

15 D.B. Audretsch, "The dynamic role of small firms: evidence from the US", 18(1–3) Small Business Economics 13 (2002).

16 C. Himmelberg & B. Petersen, "R&D and internal finance: A panel study of small firms in high-tech industries", 78 Review of Economics and Statistics 38 (1994).

In Canada, Japan, and Europe, SMEs are less inclined to patent than larger corporations. However, results from a survey of British firms suggest that smaller firms have been more than proportionally active in acquiring IPR assets.[17] The evidence for Canada also shows that the propensity to use any and all IPRs increases with the size of the firm.[18] In contrast to SMEs, which patent almost only in Canada, the largest firms tend to patent both in Canada and in the US.[19] According to evidence regarding small and medium-sized firms in Europe, the cost of obtaining a patent and the prospect of even larger litigation costs discourage small firms from patenting, especially in other countries.[20] Regression results by Arundel[21] that control for the effect of the industry sector on patent rates shows that patent propensity rates increase with firm size and are higher among firms that find patents to be an important method for preventing competitors from copying both product and process innovations. It has been found that firms of all sizes consider secrecy to be a more effective means of appropriation than patents, but that small firms value secrecy more than large firms. The preference of small companies for secrecy is presumably due to their lack of the financial resources needed to protect their patents from infringement.

It may be noteworthy that the UK patent office has in recent years reduced the application fees for patents and trademarks;[22] it remains to be established whether or not the reduced fees were behind the increased application rate in the UK.[23] A more recent, sector-specific, survey of European biotechnological firms shows that small firms use secrecy more than large ones, Italian firms most and British least frequently. Small firms tend more often to use the national patent systems, the larger ones the European Patent Treaty (EPT) and even more often the Patent Cooperation Treaty (PCT). A survey

17 C. Greenhalgh, M. Longland & D. Bosworth, "Protecting intellectual property: British, European and American patents and trademarks of selected UK companies", 1986–95. Oxford Intellectual Property Research Centre, Electronic Journal of Intellectual Property Rights, http://www.oiprc.oxac.uk/EJINDEX.html.

18 J.R. Baldwin & P. Hanel, "Innovation and Knowledge Creation in an Open Economy-Canadian Industry and International Implications", (New York and Cambridge, UK: Cambridge University Press 2003).

19 P. Hanel, "Protection of intellectual property by manufacturing firms in Canada". in: G. Fred (ed.), "Understanding Innovation in Canadian Industry" 261–292 (McGill-Queen's University Press 2003).

20 U. Tager & A. von Witzleben, "PATINNOVA '90: Strategies for the Protection of Innovation: Proceedings of the First European Congress on Industrial Property Rights and Innovation" xi (Kluwer Academic, Norwell, MA and Dordrecht; Deutscher Wirtschaftsdienst, Cologne 1991).

21 A. Arundel, "The relative effectiveness of patents and secrecy for appropriation", 30 Research Policy 611 (2001).

22 D.A. Burge, "Patent and Trademark Tactics and Practice", (Wiley, New York 1999).

23 C. Greenhalgh, M. Longland & D. Bosworth, Protecting intellectual property: British, European and American patents and trade marks of selected UK companies, 1986–95. Oxford Intellectual Property Research Centre, Electronic Journal of Intellectual Property Rights 2001, http://www.oiprc.oxac.uk/EJINDEX.html.

of 600 SMEs from all EU states that obtained a European or US patent between 1994 and 1997 conducted by the University of Dublin found that:

- Two-thirds of the sample firms had experienced attempts to copy their patented inventions, but only one in five actually used courts to defend their patents.
- For 49% of the firms, fear of cost of patent defense litigation had a "very big" or a "significant" impact on their investment in invention.
- The current patent system works poorly for SMEs, especially in the US, where large companies use their substantial available resources to intimidate SMEs.
- For SMEs, patenting is currently not cost-effective as a means of protecting IP.
- Only in very rare cases are penalties for infringement awarded in practice.
- Compulsory expert arbitration should be investigated as a solution to the excessive cost of patent litigation.[24]

The relative strength of the patent regime appears to affect the direction rather than the magnitude of investments in research and development made in a country. Seyoum[25] uses empirical findings based on a study of 27 countries. They support the proposition that the level of IPR protection is a strong determinant of inward investment and that IP rights have a greater impact on inward investment than many economic policy variables among certain country groups. According to Ostergard,[26] prior measures of IP strength lack a component that addresses the actual enforcement of these laws. His measure uses three types of IPR laws and enforcement components for them. However, in several newly industrializing countries, Brazil, Turkey, and Mexico to name only a few, the absence of patent protection has not prevented multinational pharmaceutical firms from entering the local market and claiming an important market share. Strong brand promotion and product differentiation of drugs played a more significant role in appropriating returns than did IPRs.[27] Membership in IP treaties increases the flow of payments and receipts for IP as long as domestic patent protection is sufficiently strong. US parents export more to subsidiaries in countries that do not adhere to such treaties but their impact on arms' length exports and foreign investment is minimal.[28] The

24 *See* "Enforcing small firms' patent rights", (University of Dublin, 2000).

25 B. Seyoum, "The impact of intellectual property rights on foreign direct investment", 31(1) Columbia Journal of World-Business 50–59 (1996).

26 R.L. Ostergard Jr., "The measurement of intellectual property rights protection", 31(2) Journal of International Business Studies 349–360 (2000).

27 P. Zuniga & E. Combe, "The effects of strengthening intellectual property rights in the pharmaceutical sector; the Mexican case", Paper presented at the 78th International Conference of the Applied Econometrics Association: Innovations and Intellectual Property-Economic and managerial perspectives, Brussels, November 23, 2001.

28 M.J. Ferrantino, "The effect of intellectual property rights on international trade and investment", 129(2) Weltwirtschaftliches Archiv 300 (1993).

Canadian experience points in the same direction. Canadian firms also tend to export more to those countries where their IPRs are highly safeguarded.[29]

V. Theoretical Framework

Maintaining the competitive advantages of a company depends on the ability of the company to protect its ideas and innovations against competitors, because competitors will try to copy such innovations. For this reason, innovative companies have different available options for protection. A description of these options can be found in the research by such authors as: Scherer et al.,[30] Geroski,[31] Dosi,[32] Arundel,[33] and Cohen et al.[34] Knowledge characteristics of technology and firm size are the most important factors in protecting innovation in companies, factors that are described in detail in the following scholars' research: Cohen et al.,[35] Durak,[36] Hurmelinna et al.[37] However, there is a lack of studies in the existing literature regarding the effect of both factors for selecting the methods of intellectual property. Two further studies show the importance of human resource capability in terms of obtaining the benefits of ownership of the innovation factor (Maurer and Zugelder,[38] Casper and Whitley[39]), and we can also find research on the

29 M. Rafiquzzaman & S. Ghosh, "The importance of the intellectual property rights systems to economic performance: A study of the Canadian experience", in: "Industry Canada International Conference on Intellectual Property and Innovation in the Knowledge-Based Economy", Toronto, May 2001.

30 F.M. Scherer, S. Herzstein, A. Dreyfoos, Jr., W. Whitney, O. Bachmann, C. Pesek, C. Scott, T. Kelly & J. Galvin, "Patents and the corporation: A report on industrial technology under changing public policy", Harvard University, Graduate School of Business Administration (2nd ed. Boston, MA, 1959).

31 P.A. Geroski, "What do we know about entry?", 13 International Journal of Industrial Organization 412 (1995).

32 G. Dosi, "Sources, procedures, and micro economic effects of innovation", 26 Journal of Economic Literature 1120 (1988).

33 A. Arundel, "The relative effectiveness of patents and secrecy for appropriation", 30 Research Policy 611 (2001).

34 W.M. Cohen, A. Goto, A. Nagata, R.R. Nelson & J.P. Walsh, "R&D spillovers, patents and the incentives to innovate in Japan and the United States", 31 Research Policy 1349 (2002).

35 W.M. Cohen, R.R. Nelson & J.P. Walsh, "Protecting their Intellectual assets: appropriability conditions and why US manufacturing firms patent", Working paper 7552, www.nber.org/papers/w7552 (2000).

36 K.T. Durack, "Tacit knowledge in patent applications: Observations on the value of models to early US Patent Office practice and potential implications for the 21st century", 26 World Patent Information 131 (2004).

37 P. Hurmelinna, K. Kylaheiko & T. Jauhiainen, "The Janus face of the appropriability regime in the protection of innovations: theoretical re-appraisal and empirical analysis", 21(2) Technovation 180 (2007).

38 S.D. Maurer & M.T. Zugelder, "Trade secret management in high technology: A legal review and research agenda", 11 The Journal of High Technology Management Research 155 (2000).

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topics "legislation systems" (Shapiro, 2001),[40] "factor-strategic innovation in companies" (Arundel, 2001; Cohen et al., 2002; Galende, 2006),[41] and "human resources factor" (Galende, 2006, Hertzfeld et al., 2006)[42].

Among the most important studies in this context are the studies by Gonzalez and Nieto-Antolin,[43] which have analyzed some mechanisms applied by companies to monopolize their innovation achievements. The authors argue that two classifications are effected by manufacturing companies to select the protection mechanism. On the one hand are the products' technological innovation characteristics, including implicitness, complexity, and uniqueness, and on the other hand company characteristics such as size and human resources which are important in decision making. Also, research and development and learning are two main components for technology change in different industries. Furthermore, due to the nature of technology, the technology cycle is different in various industries.[44] There are different mechanisms to use the revenues of learning, and these depend on factors like the capabilities of the existing work force, skill level, and production circulation. Some mechanisms are "learning by making", "learning by imitation", "learning by process", and "learning by doing".[45] Argote and Epple[46] and Arrow[47] have also pointed out these factors in their research.

There are some gaps to fill in the literature; first of all, the authors have rarely identified factors in developing countries. Second, none of the studies have focused directly on the level of incentive for using IP in manufacturing companies in developing countries based on their activity. The conceptual model proposed in this paper is based on the framework provided by Ghazinoory et al.[48] In this study, the authors identified indicators on three levels, including

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39 S. Casper & R. Whitley, "Managing competences in entrepreneurial technology firms: a comparative institutional analysis of Germany, Sweden and the UK", 33 Research Policy 89 (2004).

40 C. Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools and Standard-Setting", available at: http://haas.Berkeley.edu/shapiro/thicket.pdf [accessed 20 April 2009].

41 J. Galende, "The appropriation of the results of innovative activity", 35 (4) International Journal of Technology Management 107 (2006).

42 H.R. Hertzfeld, A.N. Link & N.S. Vonortas, "Intellectual property protection mechanisms in research partnerships", 35 Research Policy 825 (2006).

43 N. Gonzalez & M. Nieto-Antolin, "Appropriability of innovation results: An empirical study in Spanish manufacturing firms", 27(1) Technovation 280 (2007).

44 C. Carraro, R. Gerlagh & B.V. der Zwaan, "Endogenous technical change in environmental macroeconomics", 25 Resource and Energy Economics 1 (2003).

45 D. Ambuj & B.V. der Zwaan, "Technological innovation in the energy sector: R&D, deployment, and learning-by-doing", 34 Energy Policy 2601 (2006).

46 L. Argote & D. Epple, "Learning curves in manufacturing", 247 Science 920 (1990).

47 K. Arrow, "The economic implications of learning by doing", 1962 Review of Economic Studies 155.

48 S. Ghazinoory, S. Abediand & B. Mashari, "Model for IP Protection based on an Empirical Study of Iranian Nanotechnology Companies", 16 Journal of Intellectual Property Rights 27 (2011).

organization characteristics, environmental characteristics, and innovation characteristics; then, based on two indexes, financial ability and matrix organizational learning capacity, a different mechanism for protecting IP was proposed. Based on their proposed matrix, contrasting the two mentioned factors and considering the area and function of each factor in the companies examined, the model for selecting four positions for protecting innovations can be proposed. Thus we can categorize our conceptual model (as shown in Figure 1) into three levels, including research and development characteristics, environmental characteristics, and technological characteristics.

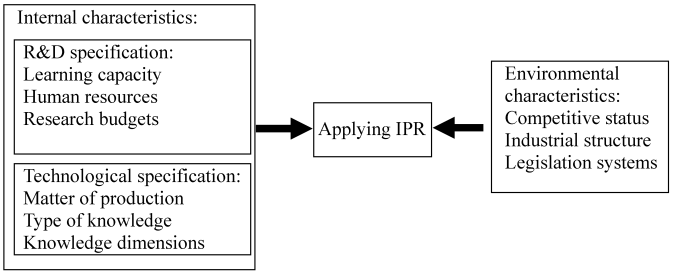


Figure 1 – Conceptual Model

In continuing, we will measure the correlation between these factors and the motivation for using IP by means of a research methodology using the identified factors and taking into consideration the nature of the industrial company in Iran.

VI. Research Methodology

Qazvin Province, which is home to five industrial parks, is one of the largest and most active industrial areas in Iran. Considering the importance and location of this area, Qazvin Province has been taken as a statistical population for our research sample. According to statistics of the Iran Industrial Park Organization, there are 550 registered companies in this area, of which 340 are active, 60 semi-active, and the rest inactive. Based on statistical parametric methods and assuming a normal population level with error ($e = 5\%$) and a confidence level of 90% ($\alpha = 10\%$), and including the number of active companies ($N = 340$) and standard deviation ($\sigma_x = 0.5$), the resulting number of sample firms for this research will be 180 companies. According to the presented conceptual model and with regard to determining the number of sample firms for data collection we designed an experiment for checking the accuracy of our results. For this purpose we classified our three adjusted indicators, "number of employees", "work experience" and "field of activity" into different studied levels. Therefore, the "number of employees" indicator is classed in three different levels: small, with fewer than 50 employees, medium, with between 50 and 100 people employed, and large, with over 100 people. The second indicator, company work experience, has been divided into three different levels:

less than five years, five to 10 years, and more than 10 years. Finally, the "company's field of activity" indicators have been divided into five categories, consisting of: spare part producers, electrical and electronics, chemical, food, and pharmaceuticals. To start the sample selection, considering factors in our experiments and having two indicators with three different levels and one indicator with five different levels, we will have 45 status levels to a sample. This means that we need 180 samples in order to have four companies in each level. The following table shows the number of active companies in each different category of activity.

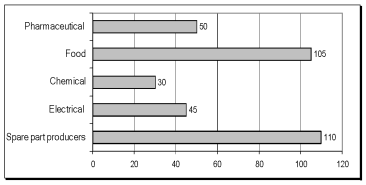


Figure 2 – Number of active companies and their field of activity

As can be seen in Figure 2 above, 62% of manufacturing companies are working in the "spare part producers" and the "food" groups. Also, Table 5 shows the different producer groups in the context of their number of employees.

Table 5 – Classification of industrial groups based on number of employees

	Industrial groups					
Number of employees	Spare part producers	Electrical	Chemical	Food	Pharma-ceutical	Total
Small	14	12	3	9	12	50
Medium	66	28	21	81	30	226
Large	30	5	6	15	8	64
Total	110	45	30	105	50	340

According to the definition for classifying companies into small, medium, and large, we can see in the above table that more than 81% of companies belong to the small and medium size levels and 19% are in the large category. Table 6 shows the number of companies based on company work experience, shown in the table by establishment year.

Table 6 – Number of companies and work experience

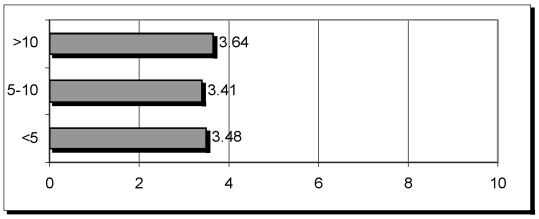
Establisment	Number of companies
Before 2001	193
2001–2005	93
since 2005	54
Total	340

VII. Results

To answer the key question of what factors contribute to the lack of motivation for developing countries to participate in production and protection of intellectual property products, we first had to study the literature related to three factors identified in the conceptual model presented here. Characteristics of research and development, technological characteristics, and environmental characteristics are the three variables in the decision-making effectiveness of production companies in the study and application of IP, in accordance with the design of the experiments done. Three additional factors, encompassing human resources, experience, and field of working were considered as secondary factors. For collecting data from the determined sample population, we designed questionnaires based on each of the primary factors. To investigate the characteristics of research and development we used four sub-indicators, for technological characteristics we used three sub-indicators, and for environmental characteristics we used three sub-indicators. Three secondary factors independent from these were extracted from the databases of the Industrial Organization of Iran. According to our determination from the sample statistic, we had selected 180 manufacturing companies. Subsequently, we sent questionnaires to all of these companies. After collecting the questionnaires, we analyzed the results. For validity and reliability of information in the first step, we had calculated Cronbach's alpha coefficient (α = .791) based on statistical tests, which shows the reliability of the questionnaires' results.

– Motivation for Applying IP, Based on "Work Experience (Year)"

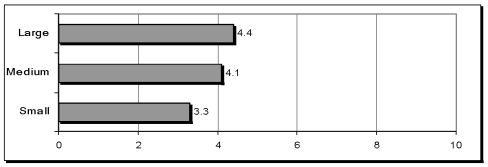
If our criterion for studying firms is "work experience", then we can find in Figure 3 that the motivation level is in the "weak" category; IP application coefficient is below 4. The level is low across the board. Although significant deviation between the data has not been observed, the experienced companies with more than 10 years' work experience have the highest motivation for IP application, with a coefficient of 3.64.



(0–2: very weak, 2–4: weak, 4–6: medium, 6–8: high, 8–10: very high)
Figure 3 – Motivation to apply IP based on work experience in industrial company

– Motivation for Applying IP, Based on "Size of Company (Number of Employees)"

If we consider the number of employees as a basis of decision for studying firms, then motivation levels for small companies can be observed in the "weak" category, as shown in Figure 4. Medium-sized and large companies are in the "medium" motivation category. In this categorization, although we do not have notable data deviation in the observed data, companies with more than 100 employees, with a coefficient of 4.4, have the highest motivation for IP application.

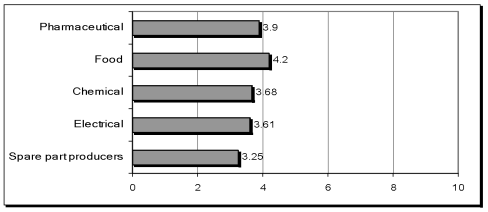


(0–2: very weak, 2–4: weak, 4–6: medium, 6–8: high, 8–10: very high)
Figure 4 – Motivation for applying IP based on size of companies in industrial company

– Motivation for Applying IP, Based on "Field of Work"

Taking "field of work" as the next category, Figure 5 shows that motivation among pharmaceutical, chemical, electrical, and spare part producers for applying IP is "weak". Producers of foodstuffs are in the "medium" category. In this division as well there is not any notable data deviation in the observed data. Nonetheless, food producers have the highest motivation for applying IP, with a coefficient of 4.2.

In this section, we showed the level of motivation to apply IP within the studied companies based on different considerations. The results also present that, when we look at the different types of companies without breaking them down into the above categories, the "applying IP" coefficient amounts to 3.51, with a deviation of 0.49, which places overall motivation for applying IP in the "low" level.



(0–2: very weak, 2–4: weak, 4–6: medium, 6–8: high, 8–10: very high)
Figure 5 – Motivation for applying IP based on industrial "field of work"

VIII. Analysis

To evaluate the correlation between lack of motivation to apply IP in Iranian companies and identified factors, including the features of research and development, technology, and environment, and to determine whether they are a good basis for analyzing the data, we used correlation coefficient analysis. The results of this analysis are shown in Table 7.

Table 7 – Analysis of the correlation factors

	Environmental	Technological	R&D
Work experience (year)			
<5	.507**	.287*	.938**
5–10	.362**	.343**	.926**
>10	.329*	.315*	.916**
Size			
Small	.410**	.393**	.726**
Medium	.335**	.209	.832**
Large	.404**	.224	.937**
Field of work			
Spare part			
producers	.403*	.056	.919**
Electrical	.630**	.617**	.924**
Chemical	.198	.377*	.954**
Food	.461**	.262	.934**
Pharmaceutical	.639**	.131	.948**
Total	.388**	.315**	.934**

N = 180
*P < 0.05
** P < 0.01

– **Motivation for Applying IP, Based on "Size of Company (Number of Employees)"**

Considering the categorization of companies based on number of employees and effectiveness of identified factors on motivation for applying IP, the results show that in the "small companies" category, the research and development factor has the highest correlation (0.726), and the technology factor has the lowest correlation (0.393). In the "medium" size category, the research and development factor has the highest correlation (0.823), and the technology factor has the lowest correlation (0.209). And finally, in the "large companies" category, the research and development factor has the highest (0.973) and the technology factor the lowest correlation (0.224). According to the analysis in the above table, the research and development

factor is the factor most strongly affecting motivation for applying IP in companies with categorization based on the number of employees. Increasing the number of employees will lead to a higher effect of the research and development factor on a company's motivation to apply IP.

– Motivation for Applying IP Based on "Work Experience (Year)"

Companies with less than five years of experience have a research and development factor with the highest correlation (0.938) and a technology factor with the lowest correlation (0.287) with the measured motivation for applying IP. Companies in the sector between five and 10 years' experience have the highest correlation in the research and development factor (0.926) and the lowest correlation in the technology factor (0.343) of motivation for applying IP. And finally, among firms with more than 10 years of experience, the research and development factor has the highest correlation (0.916) and the technology factor the lowest correlation (0.315) with motivation for applying IP. According to the analysis of decision variables as illustrated in the above table, the most important factor to affect the motivation to protect IP in manufacturing companies, based on the company experience categorization, is the research and development factor. This connection in companies with work experience of less than five years has a correlation coefficient equal to 0.938. The connection has close relationship with company experience. In other words, with increasing company experience, the effect of this factor will decline. As we can see, there is lowest effect in companies with work experience of over 10 years.

– Motivation for Applying IP Based on "Field of Work"

According to the different division of firms' activity based on the identified factors that effect the motivation to apply IP, the following results were calculated. In the category of spare parts producers, the research and development factor has the highest correlation (0.919), and the technology factor has the lowest correlation (0.056) with motivation levels. In the electronics group, the research and development factor has the highest (0.924) and the technology factor the lowest correlation (0.617) with motivation levels. In the chemical group, research and development has the highest correlation (0.954), and the environmental factor shows the lowest correlation (0.198), with motivation to apply IP. In the food section, research and development has the highest correlation (0.934) and technology the lowest correlation (0.262) with motivation to apply IP. Finally, in the pharmaceuticals section, the research and development factor has the highest correlation (0.934), and the technology factor shows the lowest correlation (0.315). According to the analysis of decision variables, as shown in the above table, the most important factor that affected the motivation of manufacturing companies to apply intellectual property is the research and development factor. When we consider all three decision criteria, research and development, technological capabilities, and environmental factors, without considering the secondary factors of size, work experience, and field of work, the most important factor that correlated with motivation to apply IP is clearly research and

development (0.934), followed by environmental factors (0.388) and technological capabilities (0.315), alternately.

Also, if we study the motivation factor with other decision factors, considering motivation factors as the response variable and three additional factors, research and development, technological capabilities, and environmental factors, as predictor variables, by using regression analysis, this yields the results shown in Tables 8 and 9. These show that, based on over 80% R-square coefficient in all levels, there is a significant relationship between the identified factors and motivation for applying IP in Iranian companies. An R square of over 80% in all sectors means that more than 80% of changes in motivation for applying IP has to do with internal and environmental features, and shows the high reliability of the results.

Table 8 – Regression analysis of "work experience" and "size" factors

	Work experience (year)			Size		
	<5	5–10	>10	Small	Medium	Large
Constant	.549**	.563**.	.715**	570**	.437**	.772**
R&D	1.019**	1.028**	.979**	995**	1.025**	1.014**
Technological	.088*	.064**	.099*	.068**	.147	.051
Environmental	.23**	-.31*	.66**	.30**	.87**	-.49**
R square	.886	.899	.847	.861	.889	.881
Adjusted R square	.880	.893	.839	.853	.883	.874
Sig level	.000*	.000*	.000*	.000*	.000*	.000*

* P<0.05
** P<0.01

Table 9 – Regression analysis of "field of work" factor

	Field				
	Spare part producers	Electrical	Chemical	Food	Pharma-ceutical
Constant	1.165**	-.136**	.653**	.387**	1.242**
R&D	.956**	1.035**	1.082**	.932**	.903**
Technological	.113	.131**	.073*	.104	.062
Environmental	.49**	.159**	-.113	.125**	.79**
R square	.908	.874	.917	.843	.870
Adjusted R Square	.900	.863	.910	.829	.858
Sig level	.000*	.000*	.000*	.000*	.000*

* P< 0.05
** P< 0.01

IX. Conclusion

One of the important challenges in technology strategy-making in the field of industry is the design of proper IP systems within the industrial companies. Nevertheless, existing statistics and results show that the quantity of patents in the developing countries is very low and the motivation to use the IP system is weak. In an attempt to answer the central question of this study, that is, what factors affect the lack of motivation of Iranian industrial companies to protect the intellectual property rights of their products, we studied the relevant literature and formulated three factors in a conceptual model. Research and development specifications, technological specifications, and environment specifications, recognized as the three decision variables that have an influence on production companies being studied in this research project, were considered as the primary factors, and the additional attributes of size, work experience and field of work were considered as three secondary factors, according to the designed experiments. Qazvin Province, with its five industrial parks one of the largest and most active industrial areas in Iran, was chosen due to the importance and location of the area to represent the sample population in our statistical study. Results showed that the level of motivation in all of the studied companies was low and that none of them used definite mechanisms to protect the consequent rights of their products. By the way, according to the results of this research, the highest level of motivation was among the food products industry.

In the second section of research, results analysis, we examined the correlation between the identified factors and the lack of use of IP systems. It was determined that the greatest correlation was between a lack of research and development specifications and the capabilities of the studied businesses. The other two factors, technological and environmental, take the next ranks. When it comes to working experience, having less than five years of activity had the most direct relation with a lack of research and development capability. According to size, companies with more than 100 people employed had the highest capability for research and development and therefore motivation for deploying IP systems. At last, studying the field of activity, we found out that doing business in the field of electronic products shows the most direct relation with capability for research and development and therefore with motivation to deploy IP systems.

At the end of the analysis phase, we used regression analysis, introducing "motivation for applying IP" as a response variable and considering the three factors of research and development, technological, and environmental specifications as independent variables, to examine and analyze the iterations. Results show that more than 80% of the motivation is caused by internal and environmental features, as had been suggested in the research, which indicates the high validity of the achieved results. According to our segmentation of Iranian production companies by two indices, size and research and development capability, at the junction of these two factors there is a matrix, shown in Figure 6. We can study companies' situations in this respect to

learn about their motivation for applying IP. The ordinate axis appertains to the company's size, represented as small, medium, and large. The abscissa axis represents research and development capability, at three levels: low, medium, and high. Research and development performance and companies' size can be simultaneously evaluated, that is, they coincide in one of the nine possible situations. As shown in Figure 6, companies with low capability for research and development or a small size have weak motivation to apply IP. On the other hand, companies with a medium level of research and development capability have a mediocre level of motivation to apply IP. Finally, results show that the companies with high research and development capability, when of medium size, have high motivation, and when large, have very high motivation to apply IP.

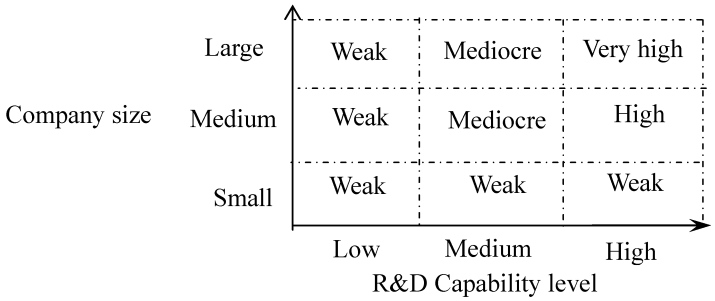


Figure 6 – Matrix for IP motivation levels in Iranian industrial companies

In the case of IP in Iran, it should be noted that the several religious authorities have argued that IPRs should not be considered as private property. Since the Islamic Revolution, Iran has witnessed many developments in the theories of religion-based jurisprudence, although no consensus has been arrived at by religious authorities as to the legitimacy of granting proprietary rights to IP creators. All indicators point to continuous growth in technical potential for development of technology in Iran, although what prevents the effectiveness of these capabilities from resulting in innovation and wealth is inadequacies in areas such as policymaking, law, commercialization, and other soft issues. Perhaps the most important causes of this backwardness, in addition to neglect on the part of policymakers, are the lack of effective international communication and the lack of participation of international companies and foreign direct investment (FDI) in Iran. Policy-makers of the national innovation system should realize that development of innovation in the current scenario requires extensive interaction with international markets and familiarity with its rules, such as the TRIPS Agreement.