



Organization Culture and Open Innovation: A Quadruple Helix Open Innovation Model Approach

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ABSTRACT

Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. Open innovation is the form of innovation in the organization that interacts with the external environment. This interaction results into adoption of either inbound or outbound innovation process. Quadruple helix (QH) model for open innovation argues the integration of industry, academia, government and society is inevitable for the organizations development. This caused challenges to the organizations to respond dynamic environment. This study has primarily examined the linear relationship, of organizational culture, on open innovation model while commitment towards open innovation moderates the linear relationship. A random sample of 250 employees from telecom industry of Pakistan is selected. The data was collected via standard questionnaire. The analysis of this study consisted of correlation analysis, multiple regression analysis and moderation analysis. The results revealed that culture has positive relationship with commitment towards open innovation, while the later one is positively associated with QH open innovation model. This relationship is moderated by commitment towards open innovation

Keywords: Open Innovation, External Environment, Quadruple Helix, Organizations Development

JEL Classifications: M00

1. INTRODUCTION

Innovation is the application of an idea/invention, technology or process to a product/service that will satisfy a specific need and can be replicated at economical cost. Innovation creates value, playing a vital role in growth and social well-being. Mounting economic pressure, environmental challenges, diminishing resources, the exponentially accelerating pace of science and knowledge development, open innovation proliferation call for a deep assessment of academia-industry relationships. Fundamental research as the sole thrust of academia is no longer a sustainable approach. Instead, innovation must focus on the integration of fundamental and applied research, technology development, new business models and processes, and enhanced social responsibility. Innovation novel blueprint mandates paradigm shifts in mindsets, strategy, research focus, academia-industry relationships, IP policies

and government involvement. Key elements include: Academia's participation in industrial development teams and technology networks, enhanced support for fundamental and applied research, advanced thesis research conducted in the industry, creation of joint-value programs and resource-sharing, new business models, and enhanced societal responsibility (Saguy, 2011).

2. OPEN INNOVATION GERMINATING THE IDEA

The idea of open innovation assumes that corporate innovation activities are more like an open system than the traditional (20th century) vertically integrated model. It was developed based on the observation of a handful of (large) innovative companies and their deviations from traditional practice (Chesbrough, 2003a, 2006).

While open innovation offered new terminology and a new managerial paradigm, as Chesbrough (2006) acknowledged, it built upon antecedents in innovation research. There are at least three antecedents that helped play a key role in both enabling the ideas of open innovation and also its acceptance among managers and scholars.

First, innovation scholars have understood since the 1970s that sources of innovative ideas often come from outside the firm. This includes the research of Freeman in the chemical industry (Freeman, 1974; Freeman, 1979). Indeed, Allen's (1984) landmark study of technology transfer of knowledge in R and D labs describes the lab itself as an "open system," relying on its external environment to help it generate ideas.

Second, open innovation builds on the profiting from innovation framework developed by Teece (1986), paying specific attention to challenges that firms face capturing returns from their innovative effort. This tradition is rooted in an understanding of the particular features of technology markets, with asymmetric relations between bargaining agents, and incomplete information and contracts (Arora et al., 2001; Gans and Stern, 2003).

2.1. Definitions of Open Innovation

Over the first decade, scholars have modified and extended the original conception of open innovation. As discussed below, we believe the papers in this special issue are part of broader themes within this evolving conception and scope of open innovation.

Even Chesbrough's definition of open innovation has evolved during this period. His first definition of open innovation was:

Open innovation means that valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well. This approach places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths... (Chesbrough, 2003a: p. 43).

One of the first large-scale empirical studies operationalized the concept as:

An "open innovation" model is using a wide range of external actors and sources to help them achieve and sustain innovation. (Laursen and Salter, 2006: p. 131).

Reflecting what was learned from the practice of open innovation, the Chesbrough, 2003a and Chesbrough, 2003b definition was revised 3 years later to emphasize the intentionality of the knowledge flows into and out of the firm:

Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (Chesbrough, 2006: p. 1).

Most recently, in response to increasing interest in non-pecuniary knowledge flows (e.g., Dahlander and Gann, 2010; Chesbrough and Di Minin, 2014), the 2006 definition was extended as follows:

We define open innovation as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model (Chesbrough and Bogers, 2014).

In its first decade, open innovation had a tremendous impact on research and practice. Through the end of 2013, the phrase "open innovation" appears in the title of 687 publications according to the Scopus database (418 publications in SSCI, SCI and other articles indexed by Web of Science) and 3150 according to Google Scholar. When seeking this phrase in the title, abstract and keywords, the number of publications rises to 1628 for Scopus and 996 for Web of Science. Open innovation has also influenced other research in strategy, management and innovation studies beyond papers primarily about open innovation. In the same period, open innovation: The new imperative (Chesbrough, 2003a) had 2179 citations according to Scopus and 7300 according to Google Scholar. For the academic sequel, open innovation: Researching a new paradigm (Chesbrough, 2006), the total was 836 citations in Scopus; in Google Scholar, the overall book recorded 1470 citations, plus 661 for its most influential chapter (Chesbrough, 2006).

To summarize and synthesize insights from this groundswell of interest, open innovation has attracted a range of literature reviews, which we will not attempt to summarize here (e.g., West et al., 2006; Enkel et al., 2009, Dahlander and Gann, 2010; Chesbrough and Bogers, 2014; West and Bogers, 2014).

Although the original open innovation book drew on deep currents of research in the broader traditions of management and economics, it did not itself seek to directly align to existing underpinning theories in these fields. Over the past 10 years, researchers have sought to find mapping of concepts of open innovation to more general theories about the nature of the firm and its boundaries (Vanhaverbeke and Cloudt, 2014).

2.2. Quadruple Helix (QH)

QH as a model of innovation reflects in many ways several features common to new thinking in innovation process and innovation policy. Innovation policies have recently been confronted by a multitude of pressures to change. Some of these originate from external developments, some from internal policy issues. National responses to the challenges include both structural and behavioral renewals in innovation policies. The reforms have also their local and regional consequences. An overall development trend is that the dominant innovation policy model, based on a linear view and a focus on science-push and supply-driven high-tech policy, is enhanced and complemented by a new and broader approach than before. Some have called this new emergent approach broad-based innovation policy (Edquist et al., 2009).

The broad-based approach means that also non-technological innovations, such as service innovations and creative sectors, are becoming more attractive as innovation policy targets. In addition, the notion of innovation is no more restricted to activities carried out by businesses. Broad-based innovation policy can be extended to encompass wider societal benefits and measures targeted to

support service innovation in the public service production. One thing that also broadens the innovation policy activities is a shift of focus from the specialization and narrow spearheads of innovation to a variety of decentralized, horizontal and functional measures supporting innovation activities on a broader base and more comprehensively.

The overall aim of the research is to explore and further define the QH concept in innovation and to explore the roles of various stakeholders within it with a particular focus on local government: (1) Exploring and defining the QH concept (2) Exploring the role of civil society in QH in connecting companies (particularly SMEs), civil society and innovation (3) Identifying good practices in implementing QH (4) Identifying roles and good practice for local authorities in promoting QH.

2.3. QH Innovation Model?

“QH” is not a very well-established and widely used concept in innovation research and in innovation policy. The concept does not have a well-established definition either. A clear springboard for this concept is of course the triple helix (TH) concept. TH describes spiral-shaped innovation cooperation between firms, universities and public organizations. The concept tries to capture the multiple reciprocal relationships of different innovation actors at different points of innovation process. QH adds another helix and actor group to the TH innovation TH cooperation model. After reviewing literature related to R and D and I activities, we arrived at the conclusion that there is a wide range of conceptions or approaches, which could be named as QH type of innovation conceptions. Some of them are very close to the TH concept, some of them deviate more radically from it, and many of them are somewhere between these two extremes. What is common to all QH type of innovation conceptions is they all have included some fourth group of actors into TH model. As we have already brought forth, we argue that this fourth helix should be users. Accordingly QH can be seen as describing innovation cooperation between firms, universities, public organizations and users.

Based on the above, we have formed a general definition of the QH innovation model: It is an innovation cooperation model or innovation environment in which users, firms, universities and public authorities cooperate in order to produce innovations. These innovations can be anything that is considered useful for innovation cooperation partners; they can be, for example, technological, social, product, service, commercial and non-commercial innovations.

As we can see, it is more useful and meaningful to consider QH rather as a continuum or space than a single entity. Accordingly it is more useful to talk about different QH models situated somewhere along the QH continuum or space. In each case, the QH model to be constructed depends on the perspective that one chooses. In this research report we consider it mainly from the innovation perspective, especially innovations related to the development of products and services either in the private or public sector.

When the roles public authorities (inc. regional and local authorities) in promoting QH are considered, it must be noted that

the role of public authorities and the ways they have been affected by the QH activities is still an under-researched and -documented topic. There is a lack of research, for example, on the roles of different public authorities - what kind of role different public actors, e.g. state, regional and local authorities have - in QH type of innovation activities and on the challenges user involvement sets to the public authorities. However, we can find good ideas and examples of the possible roles of regional and local authorities from the living lab literature, from our good QH case studies, from the four QH models formed by us and from the user-driven innovation policy literature (Arnkil et al., 2010).

2.4. QH Model of Innovation and Related Concepts

A variation of the model would add that the TH is not a sufficient condition for long-term innovative growth and that a fourth element, i.e., civil society, needs to be incorporated in order to play an active role in knowledge creation (Liljemark, 2004). Some authors consider the interaction between business, university, government, and civil society as a requirement for sustainable growth (Khan and Al-Ansari, 2005).

The QH emphasizes the importance of also integrating the perspective of the media-based and culture-based public. What results is an emerging fractal type of knowledge and innovation ecosystems, well configured for the knowledge economy and society (Carayannis and Campbell, 2009).

These authors consider that innovation goals and strategies must integrate public opinion regarding knowledge generation, innovation, creative industries, politics, lifestyles, culture, values, and art.

This fourth helix is explained by the influence of media to the public reality which influences at the same time national innovation systems. The consequence of the diversity of agents involved in the innovation process within the QH model may result in a knowledge and innovation-based democracy continuously being shaped by “the mutually interacting and influencing citizens and the dominant designs of the underlying cultures and technological paradigms” (Carayannis and Alexander, 2002, pp. 26, 27).

Some researchers (Delman and Madsen, 2007) also speak about fourth pillar organizations leading to QH structures. Fourth pillar organizations are independent, not-for profit, member-based organizations which combine funding from the government and the private sector. Fourth pillar organizations provide a facilitating role among the three traditional pillars. They are typically structured as independent, not-for-profit entities and leverage private and public investment to implement shared-cost R and D programs, build shared R and D infrastructure, and supply technical products and services. These kinds of organizations are considered to be important players in innovation systems as they work in the border areas of, and create links between, triple-helix organizations. To do this, they create networks of industry and university leaders and build partnerships and collaborations to undertake R and D and create a national, cross-sectoral vision for R and D excellence and develop, attract, and retain highly qualified people in short, fourth pillar organizations enable innovation and amplify its impact. They bring together communities of common interest to focus on important opportunities to stimulate

innovation. Fourth pillar organizations are catalysts for strategic government investment in enabling platform technologies, the fruits other authors offer alternative views. (Kostiainen and Sotarauta, 2007) argue that companies today have become more aware of the need of collaboration in contexts where companies cannot act by themselves. Particularly, the involvement of consumers in the product and service development process is added to the TH model to add a fourth actor to build a framework where universities, government, firms, and consumers join forces of which will contribute to the development of innovation and wealth across all industrial sectors.

3. ORGANIZATIONAL CULTURE AND INNOVATIONS

The concept of organizational culture originates in cultural anthropology and is popular within the organizational behavior, management, and marketing literatures (e.g., Gregory et al., 2009; Homburg and Pflesser, 2000; Schein, 1992). Organizational culture refers to the values and beliefs that provide norms of expected behaviors that employees might follow (Schein, 1992). Schein (1992) considers organizational culture as a social force that is largely invisible yet very powerful. An organization's culture strongly influences employees' behaviors beyond formal control systems, procedures, and authority (O'Reilly et al., 1991). As such, organizational culture is a powerful means to elicit desired organizational outcomes.

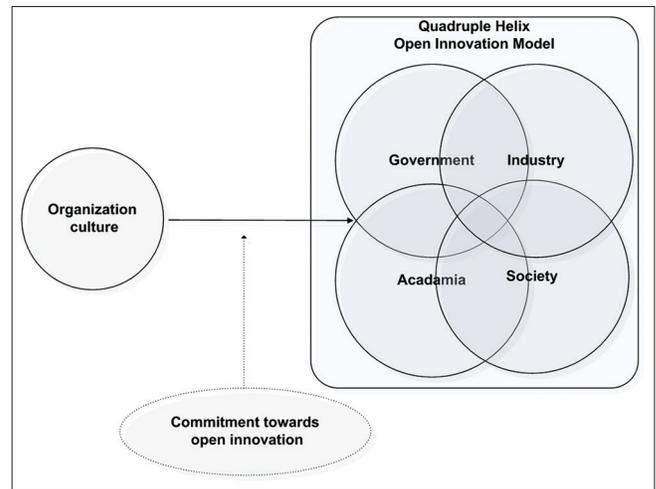
Nonetheless, despite much focused attention on the topic of organizational culture, extant literature does not sufficiently document the characteristics of an organizational culture that supports innovation. Importantly, prior research does not sufficiently document the explicit process by which organizational values (i.e. the foundational building blocks of culture) translate into observable desired behaviors. Moreover, advancing the literature requires a finer-grained view and clearer explanation of the specific layers of an organizational culture supporting innovation. "That organizational culture influences firm effectiveness is an assumption implicitly held by many managers and management researchers, although few empirical studies have provided detailed insight into the relationship" (Gregory et al., 2009, p. 683). This research begins to address this important gap. Figure 1 shows theoretical framework of the study.

A central aim of this paper is to contribute to existing literature by providing a clearer understanding of the links between the distinct layers of an organization's culture and innovative behaviors. The motivation for this paper is to provide a more complete account of the key cultural characteristics and processes that lead to innovative behaviors within a knowledge-based context. This study contributes to understanding these key issues in several ways. First, this study presents and empirically tests Schein's (1992) multi-layered organizational culture model. In contrast to most previous studies that conceptualize organizational culture as a one-dimensional construct, we build on and extend Homburg and Pflesser's (2000) work.

3.1. Organizational Values and Norms

Values theorists suggest that values develop through the influences of cultural and social contexts (Dose, 1997; Rokeach, 1973). Values espoused within an organizational environment are defined as evaluative standards relating to work, or the work environment, by

Figure 1: Theoretical framework



which individuals discern what is considered "right" or "wrong" (Dose, 1997). Values serve an important function guiding specific norms, or expectations of behavior, within organizations. Previous research provides support for the influence of certain values, norms, and artifacts on the behavior of employees. Based on a review of research and relevant literature summarized in Table 1, the literature of this study examines the values, norms, and artifacts that the literature suggests motivate innovative behaviors. We therefore assess an innovation-oriented culture through the following value dimensions: Success, openness and flexibility, internal communication, competence and professionalism, inter-functional cooperation, responsibility of employees, appreciation of employees, and risk-taking. As Homburg and Pflesser (2000) note, some values may yield other valued behaviors (e.g., pro-social displays).

Although not directly observable, values have a powerful force on norms and resultant observable behaviors (Dose, 1997; Rokeach, 1973). Norms are social expectations based on underlying organizational values and represent behavioral rules that guide actions within groups, and often specify precise sanctions for violations of these expectations (O'Reilly et al., 1991). Whereas values provide a broad foundation for an organization's culture, norms provide explicit guidance to desired behaviors. Social learning theory suggests that individuals learn values, attitudes, behaviors, and skills through observing others in a social context (Bandura, 1986). By observing others, reinforcement of organizational values and the subsequent expectations of specific behavior occurs. This implies that a set of underlying organizational values provides a basis on which to foster a set of corresponding norms, or expectations, for innovation-related behaviors. Stated formally as a hypothesis:

Hypothesis H1: The organizational culture is related with open innovation model.

Hypothesis H2: The commitment towards open innovation is related with open innovation model.

Hypothesis H3: The commitment towards open innovation moderates the relationship among organizational culture and open innovation model.

4. METHODOLOGY

The sample of 250 was selected via random probability sampling out of 500 employees from telecom sector in Pakistan. The

organizations include in the study sample were Ptel, Ufone, Telenor, Warid and Zong. This segment of education telecom sector was selected because, it was more appropriate for the research study. Firstly Telecom sector has experienced a

Table 1: Research and literature on dimensions of organizational culture that support innovation

Value dimension	Definition	Rationale	Citations
Success	The degree to which an organization values success and strives for the highest standards of performance, and values the provision of challenging goals and encouragement of employees to excel	*Raises performance expectations of employees; *creates psychological ownership of organizational goals; *enhances intrinsic motivation and feelings of self-efficacy; *increases employees' motivations to find novel solutions to organizational problems; *improves innovative performance	Abbey and Dickson (1983); Amabile, Conti, Coon, Lazenby, and Herron (1996); Gumusluoglu and Ilsev (2009); Mumford et al. (2002); Redmond et al. (1993); Sethi, Smith, and Park (2001); West (2002)
Openness and flexibility	The degree to which an organization values openness and responsiveness to new ideas, and a flexible approach to solving problems	*Facilitates creativity, empowerment, and change that are essential for the exploration that drives innovation; *encourages intrinsic interest in, and appreciation of novelty, promotes variety seeking, receptiveness to new ideas, and tolerance for ambiguity associated with creativity and innovation; *facilitates idea generation, divergent thinking that enable problem identification and implementation of creative solutions	Amabile (1988); Howell and Boies (2004); Khazanchi et al. (2007); Mumford et al. (2002)
Internal communication	The degree to which an organization values open communication that facilitates information flows within an organization	*Social development theory and situational learning theory emphasize cognitive growth through social interaction and communication of information; *provides access to and availability of diverse knowledge, cross-fertilization of ideas, improved quality of decision-making and consideration of novel alternative solutions that yield innovation	Amabile (1988); Baker and Freeland (1972); Binnewies, Ohly, and Sonnentag (2007); Caldwell and O'Reilly (2003); Garcia-Morales et al. (2011); Moorman and Miner (1997); Sonnentag and Volmer (2009)
Competence and professionalism	The degree to which an organization values knowledge and skills, and upholds the ideals and beliefs associated with a profession	*Professional knowledge, expertise and technical skills (i.e., domain relevant knowledge) constitute the raw material for innovation; *increased professional knowledge and expertise leads to increased problem analysis and solution provision, increased initiation of and adoption of technical innovations, increased total, technical and administrative innovation adoption, increased innovative human resource practices and increased radical innovation capability	Amabile (1988); Sonnentag and Volmer (2009); Subramaniam and Youndt (2005)
Inter-functional cooperation	The degree to which an organization values coordination and teamwork	*Resource dependence theory suggests that when working on highly innovative projects, members from different functional areas consider their tasks to be more heavily reliant on the expertise, information and resources of other functional specialists in order to achieve buy-in and successful and innovative outcomes; *High levels of integration and sharing among teams is facilitated through complex coordination, communication, information-sharing, cooperation and conflict resolution processes, which in turn influences innovation success	Abbey and Dickson (1983); Baker and Freeland (1972); Caldwell and O'Reilly (2003); De Clercq, Menguc, and Auh (2009); Song and Swink (2009)
Responsibility	The degree to which an organization values employees' proactiveness, initiative, autonomy and responsibility for their work	*A relatively high degree of responsibility, autonomy and encouragement of initiative fosters innovation; *when employees perceive responsibility for achieving the overall goals of a project and have discretion in how goals are accomplished they develop a sense of ownership and control over their own work and ideas, overcome potential problems with persistence and determination, and produce more creative and innovative outcomes	Amabile et al. (1996); Binnewies et al. (2007); Caldwell and O'Reilly (2003); Mumford et al. (2002)

(Contd...)

Table 1: (Continued...)

Value dimension	Definition	Rationale	Citations
Appreciation	The degree to which an organization values, rewards and recognizes employees' accomplishments	*As a directive mechanism, output expectations are more successful when accompanied by rewards and feedback, and the provision of rewards and recognition of innovative accomplishments positively influences innovation; *the synergistic effects of extrinsic motivation (e.g. recognition) and intrinsic motivation (e.g. commitment to work and exploratory learning) influence innovation; *performance reward dependency and risk-taking are positively related to all stages in the development of new technological innovations	Abbey and Dickson (1983); Amabile (1988); Howell and Boies (2004); Mumford et al. (2002); O'Reilly (1989); West (2002)
Risk-taking	The degree to which an organization values experimentation with new ideas and challenging the status quo	*Valuing risk-taking, or an encouragement to take meaningful and calculated risks within the scope of one's job, and an encouragement to challenge the status quo in an effort to produce positive job-related outcomes, is related to the psychological safety construct where employees have a sense of being able to experiment with new ideas and to do things differently without the fear of negative consequences to self-image, status or career; *encouraging risk-taking strengthens superordinate identity and when combined with supervisory support and encouragement positively influences product innovativeness	Caldwell and O'Reilly (2003); Dewett (2004); Sethi et al. (2001); Tellis et al. (2009)

significant growth since last 5 years. This sector among other industries went through phenomenal growth. Secondly the telecom industry has well-equipped with both atmospheres, i.e., internal and external. The confidentiality of data was assured and the participants were told that the data would be used only for research purpose.

The data was collected via standard questionnaires. The dependent, independent and moderating variables were tested statistically via moderated multiple regressions after exporting their corresponding average scores into SPSS 16 version.

5. ANALYSIS AND RESULTS

This study has primarily examined the linear relationship, of Organizational culture, on open innovation model while commitment towards open innovation moderates the linear relationship. The analysis of this study consisted of correlation analysis, multiple regression analysis and moderation analysis.

Correlation analysis has confirmed the relationship between independent, moderating and dependent variables. Table 2 describes the correlation score.

Hypothesis H1: The organizational culture was related positively with 'QH' open innovation model, with value of (r = 0.428). The results were confirmed that organizational culture has positive relationship with commitment towards open innovation where the value of (r = 0.463).

Hypothesis H2: The results have confirmed that commitment towards open innovation was positively related with "QH"

Table 2: Correlation analysis

Variables	CTOI	OC	OIM
Commitment towards open innovation	1		
Organizational culture	0.463**	1	
Open innovation model (QH)	0.601**	0.428**	1

**Correlation is significant at 0.01 level (two-tailed), QH: Quadruple helix

Table 3: (a) Multiple regressions over all model summary

Model	R	R ²	Adjusted R ²	Standard error of the estimate
1	0.796 ^a	0.634	0.614	0.38197

^aPredictors: (constant)

Table 3: (b) ANOVA^a

Model	Sum of squares	df	Mean square	F	Significant
Regression	22.509	5	4.502	30.855	0.000 ^a
Residual	12.986	89	0.146		
Total	35.495	94			

^aDependent variable: Open innovation model

open innovation model, the value of coefficient of correlation (r = 0.601).

The second part of analysis comprised of inferential statistics. The multiple regression model results have reported that the overall model is highly significant. The Table 3 presented the values of R², F statistics, and significance of model. The all independent variable including moderating variable explained the open innovation model to greater extent. The statistics confirmed that significance value (F [30.855] = 30.00), (P < 0.05) the coefficient of determination value was (R² = 0.614) means all the variables shows variability of almost 61% for the dependent variable speaking up at 95% probability level.

Table 4: Linear regression analysis individual models summary

Variables	R Square	Adjusted R Square	Std. error of the estimate	F	Significant
Open innovation model (QH)	-	-	-	-	-
Organizational culture	0.361	0.354	0.49387	52.525	0.000 ^a
Commitment towards (QH)	0.183	0.174	0.55832	20.869	0.000 ^a

Note: * $P < 0.05$, QH: Quadruple helix

Table 5: Moderation analysis

Variables	R	R ²	Adjusted R ²	Standard error of the estimate	F	Significant
Open innovation model (QH)						
Organizational culture	0.428 ^a	0.361	0.354	0.55832	20.869	0.000 ^a
OC with interaction term	0.474 ^a	0.380	0.371	0.54684	23.349	0.000 ^a

Note: * $P < 0.05$, QH: Quadruple helix

The second sub part of analysis consisted of linear regression. The Table 4 presented the results. The statistics have confirmed that individually all the variables were significantly explained the open innovation model. The independent variable ‘organizational culture’ explained the dependent variable ‘open innovation model’ up 35% at significance level ($F [52.525] = 52.00$), ($P < 0.05$) (adjusted $R^2 = 0.354$) at 95% probability level. The moderating variables ‘commitment towards open innovation’ explained 17% the dependent variable open innovation model’ at significance level ($F [20.869] = 20.00$), ($P < 0.05$) (adjusted $R^2 = 0.174$) at 95% probability level.

The third part of inferential statistics comprised of moderated multiple regressions. This part of the analysis includes the use of interaction term in regression model. The above Table 5 represented the comprehensive results of moderation analysis. The increased values of R^2 because of interaction term were highlighted bold in the shaded rows. The model of moderated regression was significant.

Hypothesis H3: The results supported the suggested hypothesis that ‘commitment towards open innovation’ moderates the relationship among organizational culture and ‘open innovation model’ (QH). The statistics showed that relationship has been strengthened between the organizational culture and open innovation model in addition the value of (coefficient of correlation increased from $r = 0.428$ to 0.474) where the variability of R^2 also showed improvement from (0.361 to 0.380) means first organizational culture was explaining open innovation 20% and after moderation the value increased up to 23% at probability level ($P < 0.05$) so results were supported hypothesis 3.

6. CONCLUSION

Study investigated the impact of organization culture on quadruple helix open innovation model and moderating role of organization commitment towards open innovation. Found a significant relationship of the organization culture to the open innovation. Also found that to opetamize the open innovation in vontext of industry, academia, society and government organization are required to be committed to the open innovation implementation.

REFERENCES

Allen, T. (1984), *Managing the flow of technology: technology transfer and the dissemination of technological information within the R&D organization*. Cambridge, MA: MIT Press Books, 1.

- Arnkil, R., Järvensivu, A., Koski, P., Piirainen, T. (2010), *Exploring Quadruple Helix Outlining user-oriented innovation models*. Tampere: University of Tampere, Institute for Social Research, Work Research Centre.
- Arora, D.S., Gill, P.K. (2001), Effects of various media and supplements on laccase production by some white rot fungi. *Bioresource Technology*, 77(1), 89-91.
- Bandura, A. (1986), *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall, Inc.
- Carayannis, E., Alexander, J. (2002), Is technological learning a firm core competence, when, how and why? A longitudinal, multi-industry study of firm technological learning and market performance. *Technovation*, 22, 625-643.
- Carayannis, E., Campbell, D. (2009), *Knowledge Creation, Diffusion and use in Innovation Networks and Knowledge Clusters: a Comparative Systems Approach Across the United States*. Europe and Asia: Praeger, Westport.
- Chesbrough, H., Bogers, M. (2014), *Explicating open innovation: clarifying an emerging paradigm for understanding innovation*. *New Frontiers in Open Innovation*. Oxford: Oxford University Press, Forthcoming, 3-28.
- Chesbrough, H., Di Minin, A. (2014), *Open Social Innovation*. *New Frontiers in Open Innovation*. Oxford: Oxford University Press. p169.
- Chesbrough, H., Vanhaverbeke, W., West, J., editors. (2006), *Open Innovation: Researching a New Paradigm*. Oxford: Oxford University Press.
- Chesbrough, H.W. (2006), The era of open innovation. *Managing Innovation and Change*. 127(3), 34-41.
- Dahlander, L., Gann, D.M. (2010), How open is innovation?. *Research Policy*, 39(6), 699-709.
- Delman, J, Madsen, S.T. (2007), *Nordic Triple Helix Collaboration in Knowledge, Innovation, and Business in China and India: a Preliminary Study*. Copenhagen: NIAS-Nordic Institute of Asian Studies.
- Dose, J.J. (1997), Work values: An integrative framework and illustrative application to organizational socialization. *Journal of Occupational and Organizational Psychology*, 70(3), 219-240.
- Edquist, C., Luukkonen, T., Sotarauta, M. (2009), *Broad-Based Innovation Policy, Evaluation of the Finnish National Innovation System – Full Report*. Helsinki: Taloustieto Ltd., p11-69.
- Enkel, E., Gassmann, O., Chesbrough, H. (2009), Open R&D and open innovation: Exploring the phenomenon. *R&d Management*, 39(4), 311-316.
- Freeman, A.M. (1974), On estimating air pollution control benefits from land value studies. *Journal of Environmental Economics and Management*, 1(1), 74-83.
- Freeman, C. (1979), The determinants of innovation: market demand,

- technology, and the response to social problems. *Futures*, 11(3), 206-215.
- Gans, J.S., Stern, S. (2003), The product market and the market for “ideas”: commercialization strategies for technology entrepreneurs. *Research Policy*, 32(2), 333-350.
- Gregory, B.T., Harris, S.G., Armenakis, A.A., Shook, C.L. (2009), Organizational culture and effectiveness: A study of values, attitudes, and organizational outcomes. *Journal of Business Research*, 62(7), 673-679.
- Homburg, C., Pflesser, C. (2000), A multiple-layer model of market-oriented organizational culture: Measurement issues and performance outcomes. *Journal of Marketing Research*, 37(4), 449-462.
- Khan, M.R., Al-Ansari, M. (2005), Sustainable Innovation as a Corporate Strategy. *Intellectual Assets*. Saudi Arabia: Management, Saudi Aramco, Dharan.
- Kostiainen, J., Sotarauta, M. (2007), Great leap or long march to knowledge economy: institutions, actors and resources in the Development of Tampere, Finland. *European Planning Studies*, 10, 5.
- Laursen, K., Salter, A. (2006), Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, 27(2), 131-150.
- Liljemark, T. (2004), *Innovation Policy in Canada Strategy and Realities*. Östersund: Swedish Institute for Growth Policy Studies.
- O'Reilly, M.S., Holmgren, L., Shing, Y., Chen, C., Rosenthal, R. A., Moses, M., Folkman, J. (1994), Angiostatin: A novel angiogenesis inhibitor that mediates the suppression of metastases by a Lewis lung carcinoma. *Cell*, 79(2), 315-328.
- Rokeach, M. (1973). *The Nature of Human Values*. Vol. 438. New York: Free press.
- Saguy, S.I. (2011), Academia-industry innovation interaction: paradigm shifts and avenues for the future. *Procedia Food Science*, 1, 1875-1882.
- Schein, E. H. (1992), *Organisational Culture and Leadership*. New Jersey: John Wiley & Sons.
- Teece, D.J. (1986), Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. *Research Policy*, 15(6), 285-305.
- Vanhaverbeke, W., Cloudt, M. (2014), *Theories of the firm and open innovation*. *New Frontiers in Open Innovation*, Oxford: Oxford University Press. p256.
- West, J., Gallagher, S. (2006), Challenges of open innovation: the paradox of firm investment in open-source software. *R&d Management*, 36(3), 319-331.