AJSS

Abasyn Journal of Social Sciences
Vol (12), Issue (1), 2019.

Open Access
DOI:
10.34091/AJSS.12.1.07

Small Firms, Institutions and Interactions: Low-Technology Innovations from the Perspective of Critical Realism

Muhammad Nouman, Mohammad Sohail Yunis, and Owais Mufti
Institute of Management Sciences, Peshawar

Abstract

Sectors or industries characterized by limited or no use of technology to innovate are called low-technology (LT) sectors. They are usually dominated by small firms. Identifying a dearth of academic and practitioner work, this paper helps explain how institutions within a small-firm sector and interactions of these firms with institutions influence the occurrence or non-occurrence of LT innovation. Marble sector firms primarily located in north-west Pakistan have been selected for this purpose. Advocating the need for critical realism that has been an often ignored paradigm in management research, this paper offers a unique perspective on the paradigm's fundamental tenets which are events, objects, mechanisms and causal powers through an extensive and robust qualitative analysis using case study methodology. Findings reveal strong normative and cognitive institutions but weak regulative institutions with varying levels of consistencies or otherwise in terms of small firms' interactions with these institutions. Interestingly, cognitive institutions emerge as the main barrier to LT innovation which is a key contribution of this paper along with a hard to find critical realist perspective.

Keywords: Low-technology innovation, LT innovation, institutions, interactions, critical realism

Small firms that operate within uncertain and dynamic environments characterized by use of technologies need to focus on innovations in order to compete. This is particularly important because it is the small firms that are a fundamental force driving any economy (Martini, Laugen, Gastaldi & Corso, 2013). While a number of sector-level and firm-level factors may influence innovations, what role do institutions play in this regard and how these firms interact with these institutions in order to innovate has mostly remained a less explored consideration. Understanding the issue of innovation is vital particularly because small low-tech firms operate in highly competitive sectors where profit margins are very thin and the ability to innovate successfully can significantly influence their ability to survive and sustain themselves (Woodfield & Husted, 2017; Zimmermann, 2016; Hirsch-Kreinsen, 2008a; 2008b; Hirsch-Kreinsen & Jacobson, 2008; Kirner, Kinker, & Jaeger, 2009). Literature on innovation has traditionally focused on two categories separately that is radical and incremental innovation (Bessant, 2008). Taking influence from innovation's incremental nature, there has been an of late increase in focus on investigating low-tech (LT) and low- and medium-tech (LMT) innovation. Influenced from OECD classification, LT sectors are mostly characterized by small firms having an R&D intensity of 0 – 0.9%, LMT 0.9 – 5% and HT above 5%. With a greater focus on the more 'glamorous' HT innovation, LT/LMT has been termed the 'forgotten sector' (Hirsch-Kreinsen, 2008a). One of the first evidences of a possible reviving interest in this type of innovation was the special issue of Research Policy journal on 'Innovation in Low- and Medium-Technology Industries' that was published in April 2009. The ensuing seminal works (e.g. Albizu et al., 2017; Woodfield & Husted, 2017; Fernandez-Esquinas et al., 2016; Hansen & Winther, 2014) added further voices to the growing criticism of the 'high-tech myopia' which makes us assume that economic growth results primarily from high-tech sectors and innovation in these sectors driven by R&D (Von Tunzelmann & Acha, 2005). Using evidence from case studies of 43 LT/LMT sectors in 9 EU countries Hirsch-Kreinsen (2008b) suggests that these sectors are mostly characterized by incremental or continuous innovation and the presence of

small firms. Literature on continuous innovation has continued to evolve and incorporate a broader range of perspectives (Boer & Gertsen, 2003). Within this context, institutions especially how they are placed within a low-technology sector and how small firms within the sector interact with them can significantly influence these firms' ability to innovate or otherwise. There is ample evidence within literature to suggest a dearth of research work on the role of institutions and small firms' interactions with these institutions that can help us understand the nature and dynamics of low-technology innovations (Woodfield & Husted, 2017; Zimmermann, 2016; Fornari et al., 2015; Foster & Heeks, 2013). Consequently, we strongly believe that developing an understanding of institutions because of the strong influence they can have on low-tech small firms' ability to innovate or otherwise and how these firms interact with the institutions can significantly help us understand low-tech innovation itself and identify ways and means to enhance any low-tech sector's competitiveness and profitability.

Departing from the traditional positivist and constructivist stances the objectives of this paper are to offer a critical realist perspective of how institutions are placed within a small-firm sector to influence the occurence or non-occurence of low-technology innovations and how small firms interact with institutions to influence the occurence or non-occurence of low-technology innovations. Addressing these objectives will not only shed light on the nature of low-technology innovation vis-a-vis interactions of small firms and institutions but also help develop a greater understanding of the fundemental tenets of critical realist thought.

In order to address these objectives this research study takes paradigmatic influence from critical realism (Bhaskar, 1997), an often ignored paradigmatic approach in social sciences research (Easton, 2016). Taking up a critical realist stance is vital because of the unique conceptualizations it offers in the form of causal mechanisms behind any phenomenon or event rather than getting into the overly-debated pros and cons of a positivist versus an interpretivist stance. We also believe that understanding low-tech innovation applying critical realism can help us not only offer a unique understanding of an often-ignored form of innovation but also provide interesting insights about critical realism and its fundamental tenets, help us understand these better and demonstrate the ability of the paradigm to take up research questions or issues of a varying degree and address them successfully through altenrate explanations. Consequently, various institutions relevant to a marble firms sector, the main focus of thRe study, have been conceptualized as objects or entities that are the building blocks of critical realist explanations of the world. However, these objects serve as structural components of objects at a higher level that is the small marble firms and the marble sector (Jagosh, 2019; Easton, 2016; 2010). Deriving from Sayer's (2014; 2004; 2000; 1992) explanations of critical realism, this research study provides a much needed understanding of the underlying mechanisms and causal powers in the form of interactions that small marble firms have with institutions to influence the occurence or non-occurence of LT innovation.

The Tenets of Critical Realism

Addressing ontological and epistemological considerations underpinning any empirical work remains a priority for researchers in social sciences. This in turn underscores the importance of choosing a paradigm (Collis & Hussey, 2003; Johnson & Duberley, 2000; Guba & Lincoln, 1994; Kuhn, 1970) that is at the core of a researcher's effort to generate knowledge about reality. In this regard two dominant paradigms in literature are positivism also known as empiricism, logical positivism, logical empiricism and postpositivism (Atkinson & Hammersley, 1994; Nagel, 1986; Ayer, 1959; Popper 1959) and constructivism also known as interpretivism, phenomenology and naturalism (Schwant, 2000; Lincoln & Guba, 1989; 1985; Glazer & Strauss, 1977). Proponents of both paradigms are also called 'purists' (Lincoln & Guba, 1985). Emanating from their ongoing debates that have resulted in 'paradigm wars' (Howe, 1988), is the stance of the critical realist (Bhaskar, 1997; 1989a; Collier, 1994). The fundamental tenet of critical realism is that the natural world is independent of the behaviors and actions of human beings while the social world is constructed based on the perceptions of social actors. It is for this reason that critical realists impress upon the need to differentiate between ontology and epistemology. Bhaskar (1998; 1991; 1989a) terms the lack of understanding this difference as 'epistemic fallacy' whereby one may end

up mixing the nature of reality with the knowledge of reality (Johnson & Duberley, 2000; Fairclough, 2005) Critical realists like Lawson (1997) and Sayer (2014; 2000) argue that reality is a structured open system where the 'real' includes structures with their related 'causal' mechanisms. The 'actual' includes events and processes. While the 'empirical' includes that part of the real and actual that is experienced by social actors (Fairclough, 2005).

Acknowledging the Limitations of a Critical Realist

It is pertinent to mention that like other paradigms, critical realists also face some queries which are not easy to address. For instance, it is difficult to determine whether the intransitive structures (metaphysical ontology) we construct based on our understanding are merely our imagination or real and non-empirical depiction of the actual truth (Johnson & Duberley, 2000). In an attempt to resolve these issues Sayer (1992) presents the notion of 'thought objects' versus 'real objects'. It is argued that while there is a 'reality' external of the human mind, it is not fully comprehensible because of the limitations of human conceptualization that can only determine the structure of the world up to a certain extent only. Moreover, 'truth is neither absolute nor purely conventional and relative' (Sayer, 1992, p. 83). Bhaskar (1989b) himself implies a more realistic or pragmatic solution to the problem with 'retroduction' that focuses on explaining the structures or mechanisms underlying an ostensible phenomenon. He suggests that within the social sciences, theory and reality are causally dependent on each other. Therefore, while the society influences the formation and evolution of social theory it does not mean that the social theorist 'constructs' social reality also.

Low-Technology Innovations, Institutions and Interactions

A sustained interest of innovation literature has been on developing a comprehensive understanding of innovation (Corso, Martini, & Bolocco, 2008) by studying the factors influencing different kinds of innovation (Boer & Gieskes, 2001) including institutions. Kirner et al. (2009) stress the importance of studying LT innovation at the level of firms within their sectoral context. Also, from a critical realist perspective institutions can be the key entities/objects within a small-firm sector with causal powers resulting in mechanisms that help explain the existence or non-existence of LT innovations amongst firms.

Determinants of LT innovation are influenced by a number of 'moderating conditions that include (1) firm size, (2) industrial sector the firm belongs to and (3) the environment of the country where the sector and its constituent firm exists (Souitaris, 2002; 1999). Becheikh, Landry, and Amara (2006) provide a list of 'internal variables'. Apart from firm size, they identify age of firm, ownership structure, past performance, business strategy, organizational structure, control activities, culture, management team and functional assets. A firm's human capital developed through education, training and skill development also influences innovation (Edquist, 2005). Presenting other perspectives studies find that factors influencing innovation include innovation budget (Dunk, 2007; De Jong & Marsili, 2006), internal R&D, design, advanced machinery and training (Vega-Jurado, Gutierrez-Gracia, Fernandez-De-Lucio, & Manjarres-Henriquez., 2008). The more a firm interacts with the external environment the greater the importance of design activities for innovation. Related to R&D, marketing and organizational innovations also add to a small firm's capacity to innovate. However, the influence of these innovations on firm's innovation performance (firms actually innovating and profiting from innovation) was not found (Mothe & Thi, 2010). Evangelista and Vezzani (2010) have a different conclusion. LT firms have five internal capabilities that impact their innovativeness. These include 'technological, marketing, integrative R&D, cultural and emotional capabilities' (Akgun, Keskin & Byrne, 2009). According to Huang and Chen (2010) firms can innovate better at a certain level of diversity in their technology base. Also, the more a firm engages with the market and transforms accordingly the more likely it will innovate (Liao & Rice, 2010). With regards to strategies, firms that have a diversification focus in terms of seeking collaborations with partner firms have better results from their collaborations (Lokshin, Hagedoorn, & Letterie, 2011). Firms that better utilize sources of information present in their environment perform better on innovation due to the development of their technological innovation capabilities (Yam, Lo, Tang & Laue, 2011). Firms with a market orientation and the

ability to understand and deal with institutions within a sector perform well with respect to LT innovation (Hernandez-Espallardo & Delgado-Ballester, 2009).

Institutions can be understood in terms of 'three pillars' (1) 'regulative', (2) 'normative' and (3) 'cognitive' (Scott, 2001, pp. 52). Geels (2004) gives examples of each. Provided below is combination of the two's concepts;

Table 1: *Types of Institutions Adapted from Scott (2001, pp. 51) and Geels (2004, pp. 905)*

	Regulative Institutions	Normative Institutions	Cognitive Institutions
Compliance depends upon	Expedience	Social obligation, expectations of society	Shared understanding, taken as is
Procedures or mechanisms for compliance	Coercive i.e. formal penalties placed	Normative (social pressures of disgrace or shame)	Imitation, following others
Reason or logic	Provide stability and 'rules of the game'	Appropriateness, becoming part of the group	Orthodoxy i.e. shared ideas
Legitimacy depends upon	Imposition by law	Social morality	Culturally supported & conceptualized
Examples	Formal rules, laws, incentive structures, standards, procedures	Norms, values, role expectations, duty, authority, codes of conduct	Common beliefs, shared logic of action, priorities, beliefs

The role of institutions in a system is not just to maintain inertia or stability. An essential component of the system, institutions explain the interactions between actors and other elements of the system (Geels, 2004). However for both Scott and Geels it is important to consider that their work is mainly theoretical or conceptual in nature and not supported by empirical evidence analyzed by the researchers themselves. An important aspect to understanding the role of institutions in the context of LT/LMT sectors is to establish the relationship between institutions at the national/regional level (NSI and RSI) and sectoral level (SSI). From NSI perspective a system consists of sub-systems including SSI. Thus national institutions have the ability to influence the structure of SSI through their sectoral effects (Storz, 2008). In the case of large firms, national institutions may be more influential however for small businesses sub-national institutions including sectoral ones may play a greater role (Carlsson, 2006). Countries may demonstrate similarities across NSI however differences would emerge amongst them across sectoral components of NSI (Lee & von Tunzelmann, 2005; Malerba, 2004)

Using mixed methods Radosevic and Myrzakhmet (2009) indicate that LMT firms in technology parks do not innovate more than others and have a focus on local markets. Lower rents and the possibility of accessing finance are the main drivers for firms to move to such technology parks however these parks alone are found to be lacking in terms of supporting innovation. Fisher-Vanden and Terry (2009) suggest that governments put pressure on firms to improve product quality and counter the import of better products. Latest technologies alone are not enough for firms to innovate and improve quality. Technology acquisition factors and technology absorptive capacity factors need to be in place for firms to achieve success.

Formal institutions like 'technology-forcing regulation' influence technological innovation amongst firms (Lee et al., 2010). Sources and uses of knowledge amongst HT and LMT firms are highly diversified that require a similar effort in government policy to effectively manage this variation. These policies should focus on both innovation and diffusion not just for HT but also LMT sectors. However, as decisions regarding use of technologies are mostly taken by individual managers at the firm level in line with their peculiar contexts, the diffusion policies should not be commanding and rather be facilitating. Governments should focus on provision of technological

knowledge that is quick, inexpensive and is not barred by delay-inducing official procedures (Robertson & Patel, 2007). Describing the transformation of Chinese national innovation system, it is found that government plays an important role in a system of innovation. However, the system has transformed from government-centric and firm-research organization focus to firm-centric and firm-led. Government remains the leading force in reforming the system (Sun & Liu, 2010).

Utilizing archival records and comparing institutions in three countries Casper and Whitley (2004) suggest that differences in institutional frameworks among countries and sectors including those that influence organization of labour markets influence determinants' relative influence on innovation. In another study Czarnitzki et al. (2011) finds that government implemented tax credits on R&D lead to improvement in innovation performance of firms. A potential weakness of the research is lack of clarity on which firms and sectors have been studied.

The underlying notion of interactions and networks within an industry or sector is that firms do not innovate in isolation. Rather, they collaborate and develop relationships with different elements of the system. This is particularly the case of small firms. Malerba (1999) via Faulkner (2009) highlights the need for further research to understand influence of institutions on sectoral systems' innovation and diffusion processes. Faulkner (2009, pp. 645) points out that transnational policy institutions in Europe may support innovation through 'constructive processes of regulatory ordering'. This is contrary to the common notion that the role of regulations (a type of formal institutions) is restrictive and limited mostly to monitoring innovation patterns within sectors. However, Boymal et al. (2007) indicate that institutional setup in a country can be a major hindering factor to innovation when it is influenced more by 'ideo-political than socio-economic realism'. It is recommended that the government should relinquish control and let competition take its own course. While Boymal reviews the influence of innovation policy in one context Vonortas (2002) does that in another. It is found that more than technological support it is policy consistency and involvement of all stakeholders at the local level that can help LT/LMT firms innovate and enhance their competitiveness.

A key aspect to understanding institutions is through the concept of institutional infrastructure. Presenting this infrastructure as the interplay among firms, government and non-government organizations, Cetindamar (2001) find that regulations and public pressure are the main determinants of the transfer and diffusion of environment technologies. This suggests the crucial role of institutional infrastructure. However, results suggest that these regulations have a limited effect on innovativeness and competitiveness because they are not innovation-oriented. Thus it becomes vital to understand the orientation of institutions as this affects their influence on innovation. Also, the local social context such as sub-community and its social structuring have a stronger relationship with adoption of the new technology amongst LT firms as compared to individual or farm level variables (Moxley & Lang, 2006).

Countries and sectors that suffer from weak markets, 'low retention of value-added function', limited professional capacities and 'limited institutional thickness and networks' need to have a more 'expansive' government role in funding industrial R&D (Breznitz & Zehavi, 2010, pp. 301). Taking into account the role of governments in influencing innovation amongst firms (Fisher-Vanden & Terry, 2009), there are studies which point out different forms of interactions amongst sectoral elements with a greater focus on institutions. For example, focusing on the interactions among firms, institutions and technologies Hall and Soskice (2001) observe that institutions in 'liberal market economies' provide greater support to firm competences encouraging innovation in emerging technologies (more radical innovations). On the other hand institutions in 'co-ordinated market economies' encourage incremental innovations. In another study Lee et al. (2010) observe that innovating firms strategically manage their architectural and component knowledge while remaining cognizant of uncertainties with their technological capacity to meet formal institutions.

Subrahmanya (2005) focus on comparisons of policy structure between a developed and developing economy. Findings suggest that incremental product innovations in both countries mainly come from external sources. However, due to low R&D intensity and a different policy structure extent of innovations in developing country is lesser than the developed economy. A weakness of the work is that sample selection procedures have also not be clearly elaborated. Presenting a different perspective Metcalfe et al. (2006, pp. 1283) suggest that innovation is

influenced by key individuals within organizations as well as a 'correlated understanding among heterogeneous agents whose rules of interaction are contingently instituted in socio-economic systems along unfolding scientific and technological trajectories'. Pointing out the important role of policy in influencing innovation Teubal (1997) argue for a horizontal perspective. It is suggested that policy should be oriented to all industries and sectors of the economy to achieve a wider economic impact rather than focused only on high technology sectors alone. However, Teubal's work is conceptual and theoretical in nature. Focusing on primary data and empirical evidence Santamaria et al. (2009) demonstrate that for LMT firms the traditional focus on R&D needs to be revised because such firms are influenced by other determinants of innovation also.

Methodology and Methods

Paradigmatically this research is influenced by critical realism (not considered by previous studies) in order to develop a subjectivist-epistemological-transitive (Collier, 1994) construction of the reality that helps explain the influence of institutions and firm-institution interactions on LT innovation. The perspectives of Sayer (2014; 2004; 2000; 1992) have been used for methodological application of critical realism to this research.

Thus deriving from the fundamental tenets of critical realism, occurrences of LT innovation have been conceptualized as events. The institutions are being conceptualized as the objects or entities that have causal powers (elaborated in terms of interactions) and explained through causal mechanisms (ways in which objects cause events). The research relies on use of retroduction rather than applying inductive or deductive approaches. This in turn influences the methodology and methods applied in this research. Case study approach has been applied as it offers a context-rich understanding of a phenomenon and allows for use of mixed methods (Yin, 2003).

This research is empirically based in the marble industry of north-west Pakistan. Marble is a semi-precious stone found as a natural resource in different parts of the world and possesses commercial value in many markets of the world. Following factors influence the choice of marble industry for this research;

1. Zero R&D intensity amongst firms thus confirming the LT status of the industry
2. Presence of small firms only (mining and processing units) whereby the owner or manager has a key role to play with regards to LT innovation

Applying a Two-Phase approach, mixed methods (also lacking in previous studies) have been used to collect data including semi-structured in-depth interviews, structured interviews and questionnaires derive from literature. Table 2 provides the distribution of respondents amongst the two cases (marble sectors) and the relevant data collection tools used.

Table 2: *Two-Phased Data Collection*

PHASE	TOOL	NUMBER	RESPONDENTS
I	Semi-structured In-depth Interview	12	a. Owners/Managers of mining and processing firms (6) b. Suppliers/Middlemen of marble equipment/machineries/technologies (2) c. Sector experts (2) d. Representatives of government and marble sector support organizations (2)
II	Structured Interview Questionnaire	18 70 (35 PeMaS + 35 BuMaS)	e. Owners/Managers of mining firm f. Owners/Managers of processing firm

The first phase relied on use of semi-structured interviews to help explore the nature of institutions prevalent in the sector along with preliminary findings on the interactions marble firms

have with these institutions. Findings from this phase were analysed to help generate results as well as identify issues for the structured interview and questionnaire for the second phase. The second phase data was meant to seek further depth about institutions and interactions along with validating findings from the first phase. Data has been analysed using Miles and Huberman (2014) relying on descriptive and pattern coding, memos, and frameworks.

Findings and Discussions

Besides 'structure of production' it is 'institutional setup' that forms the key dimension of any system of innovation (Lundvall, 1992, pp. 10). Freeman (1987), Lundvall (1992) and Nelson (1993) in their pioneering works underscore the institutional embeddedness of innovative firms. Conceptualizing sectoral system of innovation Malerba (2002; 2005) describes institutions as one of key elements of innovation with a sector. Four dimensions of institutions (discussed below) emerge from analysis of qualitative data. They also help in understanding the underlying causal mechanisms associated with institutions influencing occurrences of LT innovation for this research.

Institutions and Low-Technology Innovations

As stated earlier, institutions can be divided into three broad types, regulative (formal in nature), normative and cognitive (informal in nature) (Scott, 2001; Geels; 2004). Data analysis reveals that the small firms in the marble sector are mostly similar with regards to the types and roles of institutions. However, differences become more conspicuous across the mining and processing subsectors. For the two mining subsectors, the main formal institutions are mining laws, rules and procedures implemented by the government through two offices, Director General Mines and Minerals (DGMM) and Directorate of Mining (DoM). Both offices operate in the same manner as far as rules and procedures are concerned. They are responsible for the management of mineral resources. This also includes the exploration and development of these resources through implementation of Annual Development Plan (ADP) and Public Sector Development Plan (PSDP) funded schemes. Additionally, both offices regulate mining concessions (prospecting licenses, exploration licenses and mining leases) on various categories of minerals including marble. Records are maintained for mineral production, royalty and excise duty. Mine owners are responsible for paying these on annual or biannual basis mostly. Additionally mining firms are also required to perform welfare of mining community, ensure safety of mine workers, and abide by mining labor laws enforced by both offices. The formal institutions for processing subsector mainly relate to tax payments on income and revenues, payment on electricity consumption and compliance with environmental standards. Processing units themselves are either sole proprietorships or partnerships. Owners adapt a simple procedure whereby the document that provides legal status to the business consists of a stamp paper or deed prepared by the notary public with his seal and signature. It also bears signatures of the partners with a formal name given to the business.

Informal institutions within both subsectors are mainly related to local traditions, customs, beliefs, perceptions and tribal code of conduct. The region is characterized by a collectivist culture. People expect favours from others and offer favours in return (normative institution). This tendency that trickles down to the marble industry also is stronger for members of the same family, tribe and/or village. Many times friendships and relations tend to overshadow professionalism and business-oriented approach. Further details are provided in the institutional framework (Miles & Huberman, 2012; 1992) to help understand how institutions influence the occurrence or non-occurrence of LT innovations. See Figure 1.

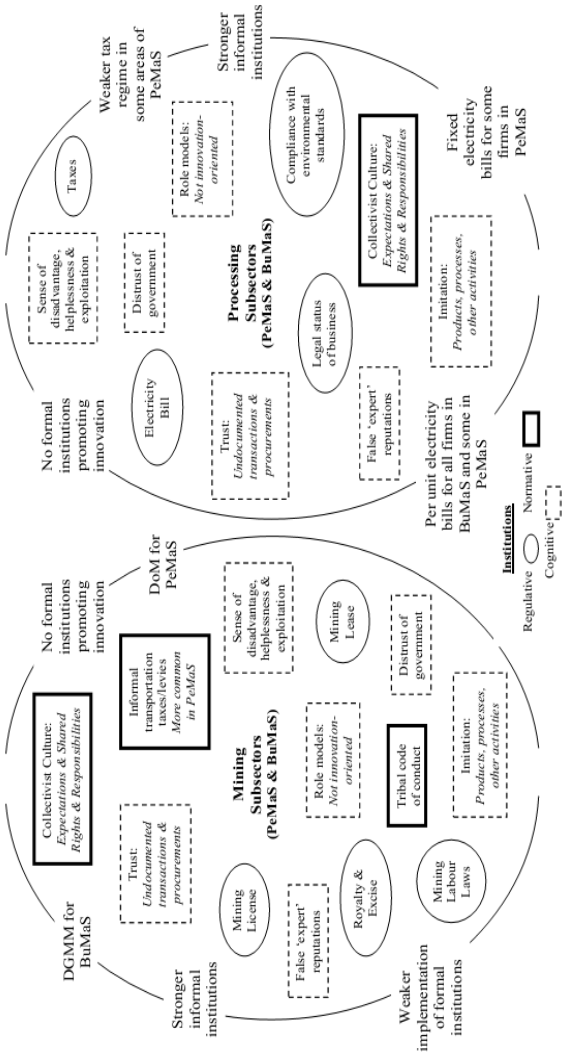

Figure 1: Institutional Framework influencing LT Innovation in Small Firms

Small-Firm-Institution Interactions and Low-Techology Innovations

Three major outcomes about mining firm-institution (MF-I) interactions emerge from data analysis that help explain their influence on LT innovation;

1. None of the MF-Is have an explicit or implicit innovation-oriented focus whereby firms are driven to innovate as a result of interactions with institutions (formal or informal)
2. Understanding influence of MF-Is in the industry is complicated by a mix of consistent versus inconsistent and strong versus weak interactions. This suggests a lack of direction and purpose of MF-Is
3. Some MF-Is especially involving cognitive institutions inadvertently serve as barriers to innovation amongst marble firms

Regulative institutions in the mining subsectors while consistently present have a weak enforcement. On the other hand different processing firms experience a different implementation mechanism for regulative institutions (suggesting inconsistency) which leads to weak enforcement. Such differences for regulative institutions suggest a lack of collective and consistent focus and priorities on the part of government and regulatory authorities to support the marble industry as a whole. Moreover firms' stronger interactions with normative and cognitive institutions, compared to regulative ones, suggest that they have limited and localized approaches towards business. Firms' goals, strategies, products, processes, marketing and resource utilization are heavily constrained by the local norms, values, culture, social obligations and a collective sense of government distrust and exploitation. The lack of innovation-oriented regulative institutions and highly restrictive and localized normative and cognitive institutions means MF-Is do not influence innovation amongst firms positively.

Outcomes also suggest the negative influence of some MF-Is on innovation amongst marble firms. In this regard interactions between firms and some cognitive institutions serve as key barriers to innovation. A strong sense of disadvantage and government distrust prevails emanating from a strong feeling that marble firms are not being provided with the desired opportunities to realize their business potential. Being part of the local community of marble businessmen, the more an owner or manager interacts with his fellow colleagues and observes the working of the industry on a daily basis the more he is convinced about his perceived sense of disadvantage. This discourages him from investing in technologies or knowledge that can lead to innovation. Further, there is a clear lack of role models (owners/managers who have achieved greater success through innovation) particularly vital as imitation is a common practice. Interactions with such cognitive institutions mean marble firms are locked in a repetitive cycle whereby businesses are being run in the same old manner without changes or innovation.

Figure 2 on provides a visual representation of MF-Is and their influence on LT innovation in the form of a framework derived from Miles and Huberman (2012). It also provides the causal mechanisms that should lead to occurrences of LT innovation. The lack of innovation is a result of the absence of these mechanisms.

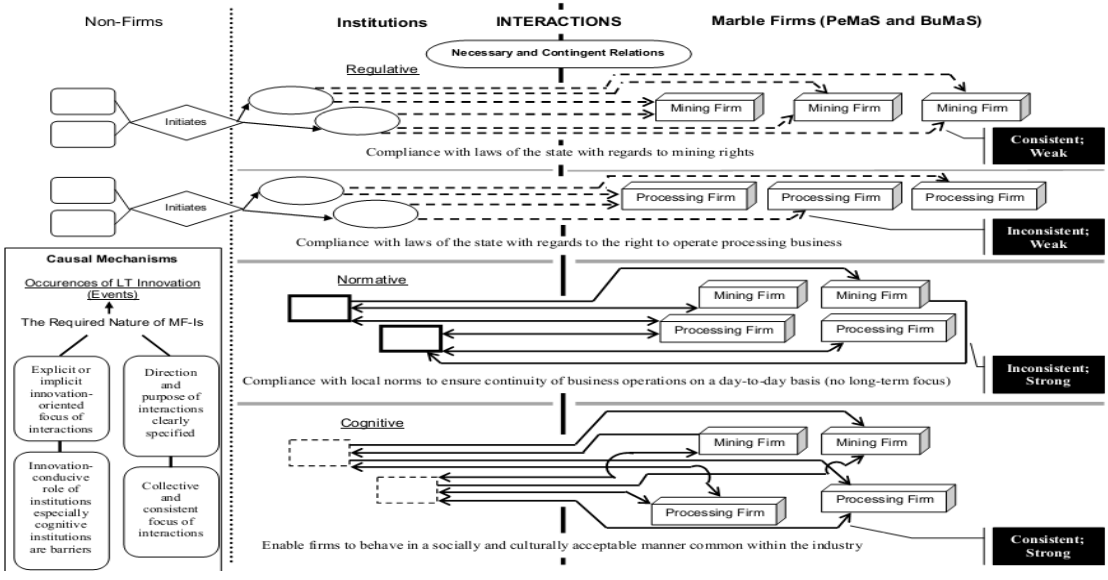

Figure 2: Marble/Small Firm-Institution Interactions (MF-I Framework) influencing LT Innovations

Conclusions and Directions for Future Research

This paper presented critical realist perspective of how institutions are placed within a small-firm sector to influence the occurrence or non-occurrence of low-technology innovations and how small firms interact with institutions to influence the occurrence or non-occurrence of low-technology innovations. Deriving from the tenets of critical realism, low-technology innovations were characterized as events in the shape of product and process innovations, institutions as objects and interactions as mechanisms and causal powers. Findings suggest differences and inconsistencies in terms of how regulative, normative and cognitive institutions are placed within two subsectors of the marble industry that is mining subsector and processing subsector. The paper reveals a unique and complex intermix of these institutions. While the four main regulative and eight normative institutions were found to result in a mix of facilitators and barriers for low-technology innovations, it is the twelve cognitive institutions particularly role models, a sense of exploitation amongst firm owners and managers, distrust of the government, vague legal status of the firm, and focus on imitation rather than originality that turn out to be the major contributors to non-occurrence of low-technology innovation. Similarly, when it comes to interactions of the small firms with institutions (MF-Is), none of the MF-Is were found to have an explicit or implicit innovation orientation. A complicated mix of consistent versus inconsistent and strong versus weak interactions was found to be the underlying causal power or mechanism behind non-occurrence of low-technology innovation.

The paper makes a unique contribution to the body of knowledge by identifying twenty four institutions and four categories of interactions for the first time that can help us understand the complex dynamics underlying the existence or lack of low-technology innovations particularly product and process innovations in small-firm sectors. Future researchers need to consider expanding the empirical boundaries of this work by investigating other small-firm sectors located in various parts of the world in order to seek theoretical consensus. Also, there is a need to attempt further theoretical generalizations by taking up similar work in large-firm sectors that exhibit low-technology characteristics. The paper is significant for policy makers and practitioners in developing countries such as Pakistan particularly Small and Medium Enterprise Development Authority, industries departments of the federal and provincial governments, business chambers, business associations, trade associations etc. It offers insights regarding the underlying mechanisms and causal powers that hinder the growth of small firm sectors such as marble through innovative products and processes in line with international market standards. The paper can serve as a valuable guide for policy makers and planners to take such initiatives in future that can minimize the negative impacts of various institutions and interactions so that the true potential of our small-firm sectors can be realized.

References

Akgun, A. E., Keskin, H., & Byrne, J. (2009). Organizational emotional capability, product and process innovation, and firm performance: An empirical analysis. *Journal of Engineering and Technology Management*, *26*(3), 103-130.

Aldas-Manzano, J., Kuster, I., & Vila, N. (2005). Market orientation and innovation: An inter-relationship analysis. *European Journal of Innovation Management*, 8(4), 437-452.

Atkinson, P., & Hammersley, M. (1994). Ethnography and participant observation. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research.* (pp. 171-198). Thousand Oaks, CA: Sage.

Ayer, A. J. (1959). *Logical positivism*. New York, NY: The Free Press.

Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003, *Technovation*, *26*, 644-664.

Bessant, J. (2008). Dealing with discontinuous innovation: The European experience, *International Journal of Technology Management*, *42*(1/2), 36–50.

Bhaskar, R. (1989a). *The possibility of naturalism*. Brighton: Harvester.

Bhaskar, R. (1989b). *Reclaiming reality: A critical introduction to contemporary philosophy*. London: Verso.

Bhaskar, R. (1991). *Philosophy and the idea of freedom*. Oxford: Blackwell.

Bhaskar, R. (1997). A realist theory of science. New York, NY: Verso.
Bhaskar, R. (1998). *The possibility of naturalism: A philosophical critique of the contemporary human sciences*. London: Routledge.
Boer, H., & Gertsen, F. (2003). From continuous improvement to continuous innovation: A retro perspective., *International Journal of Technology Management*, *26*(8), 805–827.
Boer, H., & Gieskes, J. F. B. (2001). Editorial of the special issue. *International Journal of Technology Management*, *22*(4), 338–345.
Buech, V. I. D., Michel, A., & Sonntag, K. (2010). Suggestion systems in organizations: What motivates employees to submit suggestions? *European Journal of Innovation Management*, *13*(4), 507-525.
Chang, S. J. (2003). Ownership structure, expropriation and performance of group-affiliated companies in Korea. *Academy of Management Journal, 46*(2), 238–253.
Chang, S. J., & Hong, J. (2000). Economic performance of group-affiliated companies in
Korea: Intragroup resource sharing and internal business transactions. *Academy of Management Journal, 43*(1), 429–448
Choi, S. B., Lee, S. H., & Williams, C. (2011). Ownership and firm innovation in a transition economy: Evidence from China. *Research Policy*, *40*(2), 441-452.
Collier, A. (1994). *Critical realism: An introduction to Roy Bhaskar's philosophy*. London: Verso.
Collis, J., & Hussey, R. (2003). *Business research: A practical guide for undergraduate and postgraduate students*. Basingstoke: Palgrave Macmillan.
Corso, M., Martini, A., & Balocco, R. (2008). Organising for continuous innovation: The community of practice approach. *International Journal of Technology Management*, *44*(3–4), 441–460.
De Jong, J., & Marsili, O. (2006). The fruit flies of innovations: A taxonomy of innovative small firms. *Research Policy*, *35*(2), 213-229.
Dobni, C. B. (2008). Measuring innovation culture in organizations: The development of a generalized innovation culture construct using exploratory factor analysis. *European Journal of Innovation Management*, *11*(4), 539-559.
Dunk, A. S. (2007). Innovation budget pressure, quality of IS information, and departmental performance. *The British Accounting Review*, *39*(2), 115-124.
Easterby-Smith, M., Thorpe, R., & Lowe, A. (2002). *Management research: An introduction*. London: Sage.
Easton, G. (2010). Critical realism in case study research. *Industrial Marketing Management*, *39*, 118-128.
Edquist, C. (2005). Systems of innovation: Perspectives and challenges. In J. Fagerberg, D. C. Mowery & R. R. Nelson (Eds.), *The Oxford handbook of innovation*. (pp. 118-141). New York, NY: Oxford University Press.
Entrialgo, M., Fernandez, E., & Vazquez, C. J. (2000). Psychological characteristics and process: The role of entrepreneurship in Spanish SMEs. *European Journal of Innovation Management*, *3*(3), 137-149.
Evangelista, R., & Vezzani, A. (2010). The economic impact of technological and organizational innovations: A firm-level analysis. *Research Policy*, *39*(2), 1253-1263.
Fairclough, N. (2005). Discourse analysis in organization studies: The case for critical realism. *Organization Studies*, *26*(6), 915-939.
Filippetti, A. (2011). Innovation modes and design as a source of innovation: A firm-level analysis. *European Journal of Innovation Management*, *14*(1), 5-26.
Glaser, B., & Strauss, A. (1977). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.
Guba, E., & Lincoln, Y. (1989). *Fourth generation evaluation*. Newbury Park, CA: Sage.
Guba, E., & Lincoln, Y. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research.* Thousand Oaks, CA: Sage.
Gudmundson, D., Tower, C. B., Hartman, E. A. (2003). Innovation in small businesses: Culture and ownership structure do matter. *Journal of Developmental Entrepreneurship 8*(1), 1–17
Hall, L. A., & Bagchi-Sen, S. (2007). An analysis of firm-level innovation strategies in the US biotechnology industry. *Technovation*, *27*(1-2), 4-14.

Hernandez-Espallardo, M., & Delgado-Ballester, E. (2009). Product innovation in small manufacturers, market orientation and the industry's five competitive forces: Empirical evidence from Spain. *European Journal of Innovation Management*, *12*(4), 470-491.

Hirsch-Kreinsen, H., (2008a). Low-tech innovations. *Industry and Innovation*, *15*(3), 23-37.

Hirsch-Kreinsen, H. (2008b). Low-technology: A forgotten sector in innovation policy. *Journal of Technology Management and Innovation*, *3*(3), 11-20.

Hirsch-Kreinsen, H., & Jacobson, D. (2008). *Innovation in low-tech firms and industries*. Cheltenham: Edward Elgar Publishing.

Howe, K. (1988). Against the quantitative-qualitative incompatibility thesis or dogmas die hard. *Educational Researcher*, *17*(8), 10-16.

Huang, Y., & Chen, C. (2010). The impact of technological diversity and organizational slack on innovation. *Technovation*, *30*, 420-428.

Jensen, M., & Meckling, W. (1976). Theory of the firm: Managerial behaviour, agency costs, and ownership structure*. Journal of Financial Economics*, *3*(4), 305–360.

Jimenez-Jimenez, D., Valle, R. S., & Hernandez-Espallardo, M. (2008). Fostering innovation: The role of market orientation and organizational learning. *European Journal of Innovation Management*, *11*(3), 389-412.

Johnson, P., & Duberley, J. (2000). *Understanding management research: An introduction to epistemology*. London: Sage.

Keskin, H. (2006). Market orientation, learning orientation, and innovation capabilities in SMEs: An extended model. *European Journal of Innovation Management*, *9*(4), 396-417.

Kirner, E., Kinkel, S., & Jaeger, A. (2009). Innovation paths and innovation performance of low-technology firms - an empirical analysis of German industry. *Research Policy*, *38*(3), 447-458.

Kuhn, T. (1970). *The structure of scientific revolutions*. Chicago: Chicago University Press.

Lawson, T. (1997). *Economics of reality*. London: Routledge.

Liao, T., & Rice, J. (2010). Innovation investments, market engagement and financial performance: A study among Australian manufacturing SMEs. *Research Policy*, *39*(1), 117-125.

Lincoln, Y., & Guba, E. (1985), *Naturalistic inquiry.* Newbury Park, CA: Sage.

Lokshin, B., Hagedoorn, J., & Letterie, W. (2011). The bumpy road of technology partnerships: Understanding causes and consequences of partnership mal-functioning. *Research Policy*, *40*, 297-308.

Macher, J. T., & Mowery, D. C. (2003). Managing learning by doing: An empirical study in semiconductor manufacturing. *Journal of Product Innovation Management*, *20*(5), 391-410.

Martini, A., Laugen, B. T., Gastaldi, L., & Corso, M. (2013). Continuous innovation: Towards a paradoxical, ambidextrous combination of exploration and exploitation. *International Journal of Technology Management*, *61*(1), 1-22.

McAdam, R., Armstrong, G., & Kelly, B. (1998). Investigation of the relationship between total quality and innovation: A research study involving small organisations. *European Journal of Innovation Management*, *1*(3), 139-147.

Miles, M. B., & Huberman, M. (1994). *Qualitative data analysis: An expanded sourcebook*. London: Sage.

Morone, P., & Testa, G. (2008). Firms growth, size and innovation: An investigation into the Italian manufacturing sector. *Economics of Innovation and New Technology*, *17*(4), 311-329.

Mothe, C., & Thi, T. U. N. (2010). The link between non-technological innovations and technological innovation. *European Journal of Innovation Management*, *13*(3), 313-332.

Nagel, T. (1986). *The view from nowhere*. New York, NY: Oxford University Press.

Nouman, M., & Warren, L. (2010). *Low-technology innovations within sectoral system: Reflections and manifestations*. Paper presented at the British Academy of Management Conference Management Research in a Changing Climate in Sheffield United Kingdom from September 14 to 16 2010. Retrieved November 10 2016 from https://www.bam.ac.uk/conference-2010

O'regan, N., & Kling, G. (2011). Technology outsourcing in manufacturing small- and medium-sized firms: Another competitive resource? *R&D Management*, *41*(1), 92-105.

Pullen, A., Weerd-Nederhoff, P., Groen, A., Song, M., & Fisscher, O. (2009). Successful patterns of internal SME characteristics leading to high overall innovation performance. *Creativity and Innovation Management*, *18*(3), 209-223.

Raymond, L., & St-Pierre, J. (2010). R&D as a determinant of innovation in manufacturing SMEs: An attempt at empirical clarification. *Technovation*, *30*, 48-56.

Saunders, M., Lewis, P., & Thornhill, A. (2006). *Research methods for business students*. Harlow: Financial Times Prentice Hall.

Sayer, A. (1992). *Method in social science: A realist approach*. London: Routledge.

Sayer, A. (2000). *Realism and social science*. London: Sage.

Sayer, A. (2004). Why critical realism. In S. Fleetwood & S. Ackroyd (Eds.), *Critical realist applications in organisation and management studies*. (pp. 66-89). London: Routledge.

Schwandt, T. (2000). Three epistemological stances for qualitative inquiry: Interpretivism, hermeneutics, and social constructionism. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research*. (pp. 78-119). Thousand Oaks, CA: Sage.

Souitaris, V. (1999). Research on the determinants of technological innovation: A contingency approach. *International Journal of Innovation Management*, *3*, 287-306.

Souitaris, V. (2002). Technological trajectories as moderators of firm-level determinants of innovation. *Research Policy*, *31*(6), 877-898.

Swan, K. S., & Allred, B. B. (2003). A product and process model of the technology-sourcing decision. *Journal of Product Innovation Management*, *20*(6), 485-496.

Talke, K., Salomo, S., & Rost, K. (2010). How top management team diversity affects innovativeness and performance via the strategic choice to focus on innovation fields. *Research Policy*, *39*(4), 907-918.

Vega-Jurado, J., Gutierrez-Gracia, A., Fernandez-De-Lucio, I., & Manjarres-Henriquez, L. (2008). The effect of external and internal factors on firm's product innovation. *Research Policy*, *37*(4), 616-632.

Von Tunzelmann, N., & Acha, V. (2005). Innovation in 'low-tech' industries. In J. Fagerberg, D. C. Mowery & R. R. Nelson (Eds.), *The Oxford handbook of innovation.* (pp. 407-432). Oxford: Oxford University Press.

Woodcock, D., Mosey, S. P., & Wood, T. B. W. (2000). New product development in British SMEs. *European Journal of Innovation Management*, *3*(4), 212-222.

Woodfield, P. & Husted, K. (2017). Intergenerational knowledge sharing in family firms: Case-based evidence from the New Zealand wine industry. Journal of Family Business Strategy, 15(2), 134-155.

Yam, R. C. M., Lo, W., Tang, E. P. Y., & Lau, A. K. W. (2011). Analysis of sources of innovation, technological innovation capabilities and performance: An empirical study of Hong Kong manufacturing industries. *Research Policy*, *40*(4), 391-402.

Yin, R. K. (2003). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.

Zimmermann, V. (2016). SMEs face a wide range of barriers to innovation-support policy needs to be broad-based. *Research Focus on Economics,* 130 (16), 1-8