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THE TRIPLE HELIX MODEL FOR INNOVATION: A HOLISTIC EXPLORATION OF BARRIERS AND ENABLERS

ABSTRACT

The Triple Helix model of innovation has attracted considerable attention in both developed and developing economies as an integral policy making tool to enhance innovation and promote economic development (Etzkowitz and Leydesdorff, 1997). Specifically it advocates the strengthening of the collaborative relationships between academia, industry and government to improve innovation. However, no studies have holistically examined the overall barriers and enablers in implementing and attempting to operationalise the Triple Helix model. This paper aims to contribute to the study of the Triple Helix model by investigating the main factors that influence the implementation and operationalisation of this model. The discussion begins with a description of the model, highlighting its emphasis on an evolutionary process towards developing the type of interactive collaboration which leads to all three actors achieving long term strategic goals. Following this is a discussion of the enablers and barriers in implementing the model.

Keywords: Triple Helix model of innovation; innovation; university-industry-government.

1.0 ORIGINS AND CHARACTERISTICS OF THE TRIPLE HELIX MODEL

Etzkowitz and De Mello (2004) trace the origins of the Triple Helix model of innovation back to 1967, when Julius, Director of the Netherlands Central Organisation for Applied Scientific Research, introduced the concept of a “triangle”. He stated: “*all those responsible, in one way or another, for the all-important economic development of their countries rack their brains to find the balance within the many complicated relationships in the modern eternal triangle of government, industry and science*” (Ciapuscio 1994: 17, cited in Etzkowitz and De Mello, 2004:163).

Etzkowitz and De Mello (2004) go on to describe how Sábato later adopted this idea of the “triangle” and used it as a tool to diagnose the relationships of science, academia and industry in Latin America. They describe how he found out that there were an almost total non-existence of “triangles” in Latin American countries and that this could be a factor which was blocking economic development. He suggested that in order for progress to occur, it was necessary to create dynamic science and technology interactions that contribute to the positive benefits for society. He believed in the need for a *“progression of interactions concerned with the numerous and managed activities of three “vertices” of society: “government (G); the productive structure (E); including private and government-owned companies; and the science-technology infrastructure (I), including universities, public and private R&D centres”* (Etzkowitz and De Mello, 2004:162). Sabato then hypothesised *“a set of three types of relationship among the elements of the triangle: intra-relations (within each vertex), inter-relations (within the vertices) and extra-relations (with the government directing the two other vertices)”* (Etzkowitz and De Mello, 2004: 162). According to Etzkowitz and De Mello (2004), this notion of progress was based on the government generating a process of strong interrelations among the three vertices.

This idea was further developed by Etzkowitz and Leydesdorff (1995) who later named this process of interrelations as the Triple Helix model of innovation. According to Etzkowitz and Leydesdorff (1997:1), the Triple Helix model is a *“spiral model of innovation, which is able to capture multiple reciprocal linkages at different stages of the capitalization of the knowledge”*. They argue that the Triple Helix model will be the key strategy of the national or multinational innovation agenda of the 21st century. This was echoed by Godin and Gingras (2000) who stated that in the past two decades the Canadian government had focused on the need to develop and promote stronger ties between universities and businesses through new policies and strategic programmes.

2.0 EVOLUTIONARY THEORIES AND TRIPLE HELIX MODEL

The elements of evolutionary theory in the development of the Triple Helix model were first described by Etzkowitz (2003). According to Dosi (1982) in a co-evolutionary model, two sub-dynamics (technologies and institutions) are assumed to operate upon each other and this co-evolution could be further reinforced overtime. From an evolutionary view, it is possible that a double helix to produce a fairly stable trajectory when the two sub dynamics mutually

shape each other in a co-evolution. According to Nelson and Winter (1977) through this process of ‘mutual shaping’, it is possible for instance, in a political economy, that the market and the state to create equilibrium which are disturbed by knowledge-based innovations. This process and further co-evolutions can develop along trajectories with the possibility of ‘lock-in’ and a sub optimal ‘lock-in’ can be sustained for considerable periods of time (Leydesdorff and Zawdie, 2010). The authors describe how a progression of this co-evolution will continue to reinforce each other and a third sub-dynamic develops. Leydesdorff (2005) acknowledged that this co-evolution system with three sub-dynamics is complex and can include all kinds of messy activities such as divergence and crisis.

A system of three sub-dynamics with the added degree of freedom might lead to de-stabilisation, meta-stabilisation, and globalisation (Leydesdorff, 2005; Leydesdorff and Zawdie, 2010). Therefore, the co-evolution can no longer be regarded as a linear progression and as a result of this a Triple Helix model is produced iteratively (Leydesdorff and Zawdie, 2010, Leydesdorff, 2005, Dosi, 1982; Viale, 2010).

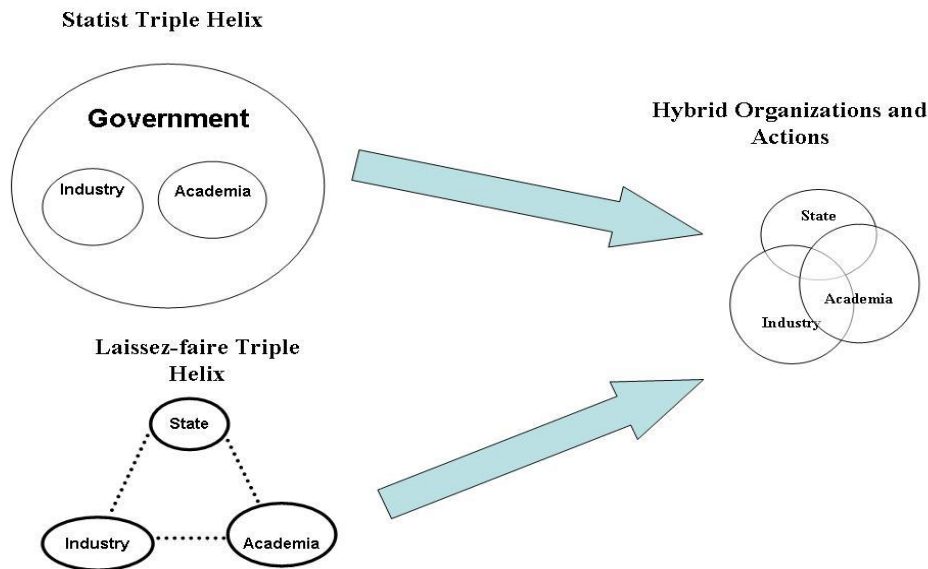
According to Leydesdorff (2012) the Triple Helix model for innovation can be regarded as an empirical method of learning and solving problems. It allows the three actors (university, government and industry) to realise issues themselves, in addition to gaining knowledge from their personal experiences

The Triple Helix model does not rule out concentrating on two of the three actors by studying for instance the university-industry relations (Clark, 1998), however according to Leydesdorff (2012) the third actors must at least be acknowledged as an additional source of variation (Leydesdorff, 2012). Triple Helix model for innovation can also be employed for policy guidance about network development, knowledge transfer, the importance of university’s role and the incubation of new start-ups (Leydesdorff, 2012).

According to Etzkowitz (2003, 2008) the evolutionary process of the Triple Helix model for innovation ends with the hybrid form of Triple Helix. According to Etzkowitz (2003) the transition towards the hybrid Triple Helix model is seen necessary for nations to benefit from maximising the synergies between the three actors. The transition starts from two opposing positions: “*a statist model of government controlling academia and industry, and a laissez-faire model, with industry, academia, and government separate and apart from each other, interacting only modestly across strong boundaries*” (Etzkowitz, 2003: 302). The next stage in the evolutionary process is the hybrid form of Triple Helix as mentioned above where one

of the key characteristics is that each institutional sphere keeps its own distinctive characteristics and at the same time also assumes the role of the others. The evolutionary process underlying the Triple Helix system is depicted graphically in Figure 3.1 below.

FIGURE 1-1:EVOLUTIONARY TRIPLE HELIX MODEL



Source: Derived from Etzkowitz (2008)

Statist Model

A major element of a statist model is that the government plays the major role in ‘driving’ academia and industry, while at the same time controlling and organising them to encourage innovation. Meanwhile, industry is regarded as the national champion, while the university’s role is reduced mainly to teaching and academic research (Etzkowitz, 2003). However, with this model, government or industry will not be able to exploit the potential knowledge generation activities within universities as both teaching and research tend to be far removed from industry needs and universities do not have any incentive to engage in the commercialisation of research (Etzkowitz, 2003).

Laissez-Faire Model

As for the laissez-faire model, governments, universities and industry operate independently as separate institutional spheres (Etzkowitz, 2003). It is expected that firms in an industry

should operate completely apart from each other in competitive relationships and are linked only through the market. The government would be limited to addressing only those problems that can be defined as market failures. In the laissez-faire Triple Helix position, industry is the driving force, with the other two actors as ancillary supporting structures (Etzkowitz, 2003). In this model, the individualistic mentality is more prominent and creates a type of heroic entrepreneur. The advantage of this model is that industry will be able to grow without any undue interventions by the government. The downside to this is that it is the system which would make it difficult for the three institutional spheres to interact in a way that would maximise the synergy in the relationships (Etzkowitz, 2008). Industries can be very strong in their own area. However they can lack understanding and fail to capture the dynamic/changing needs of their external environment which includes customers, suppliers and other institutions.

Hybrid Triple Helix Model

The third position is the Hybrid Triple Helix model. According to Etzkowitz and Klofsten (2005), the Hybrid Triple Helix Model can be described as being characterised by the following elements:

1. A prominent role for the university in innovation, on a par with industry and government in a knowledge-based society.
2. A movement towards collaborative relationships among the three major institutional spheres in which innovation policy is an outcome of their interactions rather than a prescription from the government.
3. In addition to fulfilling their traditional functions, each institutional sphere also “takes the role of the other” (Etzkowitz and Klofsten, 2005:245)

One of the main arguments of the Triple Helix model is that each actor is linked to another and helps in the structure of interfaces between them. For example, the industry will gain some of the values of the university, sharing as well as protecting knowledge. Groups of firms will collaborate with the government and universities to achieve common long-term strategic goals (Etzkowitz and Leydesdorff, 1997). The stakeholders of the Triple Helix, as well as performing their traditional functions, also engage in the roles of the others (Etzkowitz and Leydesdorff, 2001). Another main argument of the Triple Helix model is the emphasis on the importance of academia in the capitalisation of knowledge. According to

Etzkowitz and Leydesdorff (1997), in this dynamic new environment, universities are changing their mission, establishing new relationships with industry and becoming more entrepreneurial. Etzkowitz et al. (2000:326) define this new type of university as the “*amalgam of teaching and research, applied and basic, entrepreneurial and scholastic interests*”. In this model all three spheres will be able to interact and collaborate with one another actively in order to promote strong innovation activities. All of them will gain values from each other which can help them achieve common long-term strategic goals. Etzkowitz (2003) believes that universities need to be the main drivers of development towards the Triple Helix model.

3.0 CRITICISMS OF THE TRIPLE HELIX MODEL

Throughout the years, several criticisms have been directed at the Triple Helix model, in particular by Shinn (1999, 2002) and Tuunainen (2005). Shinn (1999), for example, highlighted that the Triple Helix model is considered to be theoretically vague. He is also doubtful whether the model can be accepted as well defined descriptive and analytic elements or only stay as an evocative metaphor (Shinn, 1999). For example Saad (2004) and Saad and Zawdie (2005) have expressed their doubts about the role of the institutions within the Triple Helix system as a knowledge source in the growth of national and regional innovation systems.

As mentioned in the earlier section, the evolutionary process of the Triple Helix model leads to trilateral interaction of a hybrid status. The institution keeps its own distinctive characteristics, while at the same time is able to assume the role of the other and gains values from each other (Etzkowitz, 2003). The university is expected to play a role as entrepreneur and develops capacities to help Triple Helix model institutions to achieve a hybrid status. However, it is not clear what unique characteristics a hybrid institution system would be in different contexts. Etzkowitz (2008) has mentioned the incubator movement in countries like Brazil as a direction towards a hybrid Triple Helix; however, it requires more description and maybe a further conceptualisation. Furthermore, Etzkowitz (2008) has not provided examples or proposals for other forms of hybrid Triple Helix institutions.

The Triple Helix model places a significant emphasis on the role of universities in relation to their links with other institutions, especially in developing regional innovation. According to

the main idea of the RIS, it can be applied only to effective growing regions. Based on this, it raises doubts on the application of the Triple Helix as to whether the model is suitable to use in a region where the universities do not have good infrastructure and enough knowledge capacities.

An important question relates to the issues and challenges of such universities to engage with other institutions within the Triple Helix model. This raises the question of how will these issues affect the interactive process between those institutions. Also a significant question to be addressed is how universities which are not interested in engaging in a more entrepreneurial role relate to the model. The problem with the hybrid Triple Helix is that its emergence as an institutional system could be elusive, as it involves a complex process based on high levels of commitment, understanding and trust between all three spheres (Saad, 2004). It can also lead the university to lose sight of its critical thinking and become too business oriented (Saad, 2004).

As highlighted by Etzkowitz (2003), the Triple Helix model is transitive and unstable in nature, where the process of change and development is ongoing. Etzkowitz (2003) and Etzkowitz and Leydesdorff (1997) have also used the term dynamic to describe the Triple Helix model that brings the complex and endless description and explanation of the innovation process. This nature presents difficulties in research that requires present or set time and geographical boundaries.

4.0 ENABLERS AND BARRIERS IN IMPLEMENTING THE TRIPLE HELIX MODEL FOR INNOVATION

This section discusses the enablers and barriers in implementing the Triple Helix model for innovation. There have been several empirical studies on the issues and challenges facing Triple Helix institutions, especially in developing countries (Rivera, 2010, Irawati, 2010, Ranga and Etzkowitz, 2010). The overall findings suggest there are three types of barriers relating to relationship issues, university issues and policies. These three themes are not mutually exclusive and overlap with one another.

1. Relationships issues, including the links and the different culture of work between the university, industry and government agencies.
2. University issues, mainly about the perception of status of a university and its capabilities.

3. Policies: Several countries such as in Latin America (see Sutz, (2010) Mello and Etzkowitz , (2008)) have stressed developing the right policies to integrate the knowledge activities and absence of commercialisation or intellectual property policies.

The issues regarding the links or relationships within the Triple Helix institutional system have been discussed by several authors. Mello and Etzkowitz (2008) have highlighted that the weakness of the actors, the vague status of their research interest and the inactive relations between institutions are the main reasons for the lack of effort of science and technology research into socio-economic development in Latin America. In fact, the weakness of the links between the institutions and their activities in development and knowledge production has been mentioned by several authors as one of the reasons for the lack of progress in Latin America (Sutz, 2000). This lack of interaction, also observed in Ghana (Dzisah, 2009), is the main reason for the failure of development of the country in spite of immense funding from donors and governments. He further emphasised that Ghana needs to rally its Triple Helix institutions, in particular its universities. As for the Central and Eastern Europe (CEE) countries, Ranga and Etzkowitz (2010) argued that despite the weak links and interactions, positive results can be expected in the years to come. However, the current transformations in those countries require more consistent action, increasing interaction and movement of resources to strengthen each Triple Helix institutional sphere.

Another issue related to the relationships between the Triple Helix institutions which was highlighted in research is the lack of collaborative arrangements, especially with local partners. This can be due to the lack of demand for local research to develop new technology (De Mello and Etzkowitz , 2008). The institutions are depending more on the technology developed in more advanced countries as it is more reliable and commercially viable (Bianco and Viscardi, 2008). Also the inflexible structure, strict bureaucratic procedure, lack of capabilities, lack of funding and traditional values/philosophy of universities have been mentioned in several studies as main challenges to develop a hybrid Triple Helix model in developing countries. Mello and Etzkowitz (2008) and Sutz (2000), for example, highlighted that a traditional ideological position of Latin American universities in preferring public to private initiatives has proved to be a big challenge for them to be more entrepreneurial.

In the case of Indonesia, Irawati (2010) has identified three main challenges which include the ineffectiveness of internal policy, low level of funding and the requirement for more collaboration with industry. She also stressed that significant dependence on the government

for R&D funding has created a situation where the researchers are not responding to the needs and demands from industry. The R&D programmes are in fact more linked to the vision and ideas of politicians and government officials.

Weak academic research capacity and lack of commercialisation potential of the universities were highlighted by Ranga and Etzkowitz (2010) as main challenges for universities in CEE. They have suggested that the universities need to implement clearer and consistent policies in order to enhance their entrepreneurial potential research capabilities and their commercialisation skills and infrastructure. Ranga and Etzkowitz (2010) also found that universities in most CEE countries are mainly teaching institutions with limited infrastructure and commercialisation skills.

Other research indicates that several challenges could be explained by the “unfriendly” or unsuitable policies set by governments. For example, the lack of university-industry collaboration has been mentioned by several researchers (e.g. Ranga and Etzkowitz , 2010) as the consequence of the lack of focus by governments in devising and implementing policies. Ranga and Etzkowitz (2010) have highlighted for CEE countries that the government needs to focus on policies for industrial development and educational resources to transform the universities from being teaching institutions to being more entrepreneurial. In the context of Latin America, Bianco and Viscardi (2008) highlighted that there is still a gap between research policies and strategy adopted by industry. They also suggested challenges related to policies that include the lack of national policies for the allocation of highly trained human resources, poor regional integration of knowledge generation activities and the absence of policies for the protection of intellectual property. In the case of Mexico, Rivera (2010) criticised the policies and strategies initiated by the Mexican government by highlighting that failures to achieve desired objectives were due to limited government involvement. Rivera (2010) highlighted that the Mexican government should implement a proper mechanism to promote interactions, coordination and the required structural reforms in order to achieve the country’s objectives. Rivera (2010) emphasised the lack of coordination and coherence in policy development and implementation as one of the reasons for the government’s failures in promoting innovations. As for Ranga and Etzkowitz (2010), they suggest (in the context of CEE countries) the establishment of science parks or clusters to improve the capabilities of local firms and enhance links with the Triple Helix institutions.

There has been strong interest lately in researching the notion of the Triple Helix model, such as Saad and Zawdie, (2010). The Triple Helix model provides a clear, well-argued model for capitalising on synergies between relationships between government, industry and academia it could be argued that and there is a lack of empirical evidence relating to the barriers and enablers of the development of collaborative relationships between all three actors. It is hoped that this empirical study can contribute towards identifying both barriers and enablers which influence the development of the type of collaborative relationships described in the Triple Helix model.

In the following section, this review explores research which investigates issues pertinent in the Triple Helix model in relation to the bilateral relationship between university and industry. It has been perceived to be particularly pertinent to the research questions since this bilateral relationship relates directly to the development of entrepreneurial universities is seen as a crucial to achieving the hybrid position of Triple Helix which Malaysia is attempting to achieve. Furthermore, the Triple Helix model does not rule out concentrating on two of the three actors by studying for instance the university-industry relations (Clark, 1998), however according to Leydesdorff (2012) the third actors must at least be acknowledged as an additional source of variation (Leydesdorff, 2012). While some of this research overlaps and supports the empirical findings cited above it also illuminates other factors which can be seen as enablers or barriers to Triple Helix implementation.

4.1 Perceived benefits of industry and government collaboration

Several studies which do not locate themselves explicitly in relation to the Triple Helix model have highlighted that one of the reasons that industry and universities are motivated to developing collaborative relationships is that they have mutual interests in cooperating with each other. Martin (2000) and Schibany and Schartniger (2001) have emphasised that businesses in the private sector can increase their innovation capacity and improve their competitive positions through collaboration with universities by accessing basic and applied research results, economically relevant scientific and technological knowledge; develop and test prototypes; and get support in finding solutions for problems of their products specifically. Meanwhile universities gained benefits in their cooperation with industry by adding financial resources, new technical knowledge and good practices; access to industrial information and applied knowledge that can be employed for academic research and teaching (Martin, 2000).

Alves (1998) and Nieminen and Kaukonen (2001) describe how the involvement in joint technological development projects with other Organisations and Scientific and Technological institutions, namely universities, is a promising approach to firms looking for real competitive advantages through technological differentiation. This relates to the view of Etzkowitz and Leydesdorff (1997) that the university – industry relationship emerges as a sophisticated instrument for the reinforcement of firms' competitive position through adoption of advanced, innovative and value-added technologies. The next section explores research which suggests the different factors that explain how in spite of wide recognition that relationships between academia and industry are mutually beneficial, the levels of interaction remain very low.

4.2 Social and interpersonal relationships as barriers and enablers

One common factor which was seen by researchers investigating barriers and enablers to collaborative practices between industry and academia relates to social influences including culture, norms and values. Bloedon and Stokes (1994) suggest that when one of the partners is a research institute or university, the project management by the company is often thought to be made more difficult by any cultural differences between the two partners. The problem of cultural clash usually stems from the fact that neither partner has the comprehensive management capability needed to be able to complete the project individually (Wolff, 1996). Santoro and Chakrabarti (1999) indicate that there are many factors which are important for successful collaboration of which one is cultural similarity. Pires et al. (1999) and Nieminen and Kaukonen (2001) suggest that academics find they are able to develop the strongest collaborative practices in those companies people with whom they share habits, language, and ways of working, cultural traits.

Martin (2000) suggests that the poor co-operation between industry and academia is due to various reasons, mainly associated with numerous differences between academia and industry that obstruct cooperation, frequently hindering the achievement of common objectives. This is in affinity with the core assumptions in the SI perspective that the external social environment, the social systems play an influential role in facilitating innovation.

Pires, et al. (1999) state that the university–industry interface is developed by many different ways of interpretation that lead to tensions and difficulties in creating and maintaining fruitful

collaborations. Another insight into cultural differences was given by Nieminen and Kaukonen (2001). They suggest that universities ignore the market rules by which firms abide and believe that this is in part explained by the immaturity of their services infrastructure and is exacerbated by the fact firm's technology demand is usually fuzzily formulated. Firms tend to focus on function rather than on technology, which conflicts with academic researchers' preference for technology centred arguments. Pires, et al (1999) and Martin (2000) support this view and state how the lack of an entrepreneurial, market-oriented culture in the academia leads to disregard for the practical or commercial implications of most academic research 'products'. Another key factor was described by Brockhoff and Teichert (1995) as 'people attributes'. Their findings suggest that it is factors that influence relationships rather than technological and economic ones are the most prominent influences on R&D cooperation between industry and universities. They list a wide range of factors which influence the strength of collaborative relationship success including information networking, procedural learning, learning to cooperate and know-how transfer.

As well as identifying that academics find they are able to develop the strongest collaborative practices in those companies people with whom they share habits, language, and ways of working, cultural traits Pires et al. (1999) and Nieminen and Kaukonen (2001) discovered of other factors which are important. These included universities' competencies, knowledge, and facilities, flexible policies on IPR, patents and licences, the presence of an industry-university champion, and trustworthiness. This belief in the importance of trustworthiness was shared by many researchers by Rosenberg and Nelson, (1994) and Turpin et al., (1996), where trust is the starting point and a key ingredient for determining the ultimate success in the research collaboration between partners or organisations with different cultures.

4.3 Commercialisation focus of universities, organisation forms and shared values with industry

The degree to which universities value research with a commercial orientation could be argued to contribute to whether or not researchers and industry some sense of shared values. Di Gregorio and Shane (2003) state that universities differ in the degree to which their researchers engage with industry. This is largely a consequence of the commercial orientation of university research. Some of the factors most often linked in the literature with clear commercial orientation are the overall objective of the university and the technology transfer

experience(of the university) that evaluated by the age and resources of technology transfer offices (TTOs) or by the size of industrial support for research received by the university (Di Gregorio and Shane, 2003). Santoro and Chakrabarti (1999) suggest that the factors lead to successful collaboration from the view of university is competencies, knowledge, and facilities. Therefore the most important thing which academics should be equipped with for the successful collaboration with industry is research capability (Bruce et al., 1995). Research capability includes not only the existing research results accumulated by academics, which are beneficial to industrial partners, but also the capability to meet the demand for new research from industry. Also, according to Bloedon and Stokes (1994), one of the key factors in developing university/industry collaborative research programmes and makes it a success is the presence of a company agent, such as TTO or the presence of commercial arm of university.

The different organisational forms and management styles in technological collaboration and choosing the most appropriate form and managerial attitude that constitutes shared values rather than technical issues are critical for the co-operation's success. One of these organisational forms are the incubators, as addressed and highlighted by Etzkowitz and Leydesdorf (1997). Turpin et al., (1996) suggest that collaboration between university-industry-government especially with regards to technological collaboration is a dynamic process which evolves over time as a consequence of the partners' learning process and the evolution of the external environment. They suggest that the adequacy of the organisational form is also linked to the companies' previous experience. Geisler (1995) suggest that previous experience determines the partner's capabilities in managing collaborations between universities and industry and previous success and/or failures may affect the partner's attitude towards some forms of co-operation. Pires et al, (1999) and Nieminen and Kaukonen (2001) suggest that academics find in those companies people with whom they share habits, language, and ways of working, cultural traits and that universities tend to cooperate better with firms that invest in research and development (R&D) and have human resources dedicated to that task.

4.4 BARRIERS TO THE DEVELOPMENT OF ENTREPRENEURIAL UNIVERSITIES

Cultural factors could also be seen as relating to the commercial orientation of universities. It was stated earlier how Etzkowitz and Leydesdorff (1997) believe that one of the defining

characteristics of the hybrid state in the Triple Helix model was the development of universities taking on an entrepreneurial role and in so doing developing a commercial orientation. It could be that one of the reasons that is necessary not just in terms of helping researchers meet the demands of industry but also in helping engender trust and the ability to take on the role of the other, and reduce problems caused by differences in cultures.

There is much research outside of the Triple Helix focused research which investigates the barriers to universities changing their role towards being more entrepreneurial. This too seems to relate strongly to the issue of social influences such as culture and values as described above. Bok (1990) describes how academics are concerned that if industry-academic collaboration is over-emphasised, it might have undesirable consequences for university life, and conflict with their values of academic freedom, long-term research and academic integrity. Lee (1997) suggests that collaboration with industry is likely to increase pressure for short-term research thereby affecting long-term basic and curiosity-driven research. He points out that those who fear that close collaboration are likely to interfere with the traditional academic values are unlikely to support university transfer of information. On the other hand, those without such fears offer support for such transfer. He believes that the same pattern applies to all value dimensions (university mission, academic freedom, basic research and the conflict of interest) across all academic-industry linkage mechanisms (credit for inventions, approval of user-oriented research, commercialisation of research, consulting of industry, start-up assistance for technology firms and equity investment).

The issues of values and culture could also be seen to relate to research by Howells et al., (1998). They believe that one of the key barriers to academic staff taking a proactive role in making the social contribution is associated with the academic reward and evaluation system, the so called, Research Assessment Exercise (RAE). The number of publications and teaching time are still considered as the most important academic criteria directly related to the promotion and evaluation of researchers in universities in the U. K. This relates to research by Alves (1998) who observed that in some cases the academic researchers were more inclined towards the fulfilment of their research interests and scientific curiosity than towards complying with the deadlines they agreed with their industrial partners.

Feller (1990) has advanced the argument that the efforts to foster 'privatisation of research' may actually slow down the rate of technological innovation. This is because academic research flows to the market are likely to become blocked as universities limit existing flows

of information in order to divert faculty findings to specific firms. This shift runs counter to other trends within academic research, which are designed to correct the debilitating effects that a close identification with commercial needs has had on the quality of research. Corti and Storto (1997, cited in Mitra and Formica, 1997) suggest that universities do not disseminate successfully the results of their academic research, in part because they lack adequate channels. They suggest that it seems difficult to convey to interested partners what the university does and how it can be of use to industry.

Reviewing the bilateral research also helped highlight the strength of the Triple Helix model in that including the relationship with government gives guidance as to how some of the barriers can be overcome. It also could be argued that some of the barriers to collaboration described above such as those relating to different cultures, could be overcome through the development of entrepreneurial universities. Etzkowitz (2008) highlights that government could be seen as playing a crucial role in overcoming barriers through helping facilitate the development of entrepreneurial universities. Although several researchers have found the Triple Helix framework useful in analysing barriers to innovation growth in different countries others are critical of different aspects of the model. The following section describes some of the criticisms that researchers have made.

5.0 CONCLUSION

This paper has highlighted the key aspects of the evolutionary Triple Helix model. Etzkowitz and Leydesdorff (1997) discriminate between statist, laissez-faire and hybrid Triple Helix positions. They show how the different positions relate to either blocking (statist and laissez-faire) or enabling (hybrid) synergies required to help all three actors achieve long term goals. Existing research, especially with regard to developing countries, has shown issues and challenges confronting the Triple Helix institutions that could be categorised as relationship, university and policy issues. It is hoped that this paper can contribute by providing analysis of the influences of both enablers and barriers of tri-lateral collaboration between the Triple Helix actors when implementing Triple Helix model for innovation.

The main contribution of the study is identifying the barriers and enablers towards implementing and operationalizing the Triple Helix Model of Innovation. The study concludes that there is much to learn from both the successes and the obstacles described from the countries experience. Government, university and industry policy makers can learn from barriers and attempt to leverage the enablers described in this study. One area in

particular which is required to manage both hard influences, i.e. maximise enablers and minimise barriers, but also to manage the soft management issues such as relational issues within the inter relationships of the Triple Helix set up.

As for future studies, it would be useful to investigate whether in the context of developing countries experiencing different levels of progress and development they share the same or different in enablers and barriers. One other suggestion for future research is to conduct a comparative study where comparisons with other developing countries. A comparative study between developed and developing nations would be able to provide more explanations in successfully implementing the Triple Helix model. Generally, developing countries plan to develop their own science and technology capability with the support of the developed nations, therefore it is hoped this type of comparative study will bring more explanations towards conceptualising the Triple Helix model.

Another suggestion for future study is the implementing of Triple Helix model for innovation as networks of university-industry-government relations can be considered as neo-institutional arrangements that can be explored and investigated as subject of social network analysis. This model can also be used for policy advice about network development, for example in the case of transfer of knowledge and the incubation of new industry (Godin & Gingras, 2000; Shinn, 2002).

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