A Conceptual Model of the role of University-Industry Collaboration in a National Systems of Innovation

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Research Objective

To understand the problem issues related to University-Industry collaboration in Iran through an investigation of the factors from the literature, models and evidence from other countries.

The first question from this research was “Can this information be conceptualized into a useable model?”

The second question was to examine the behavioural drivers and barriers to collaboration between University research groups and Industry, and “Can behavioural aspects be embedded into a unified model?”

• What factors motivates the individual within universities to collaborate with industry?
• What factors motivates universities to collaborate with industry?
• What factors motivates industry to collaborate with universities?
• What factors are barriers to any UIC?
• What changes are likely to promote more effective UIC?
• What are the roles of culture and trust in these relationships?
Macro Economic Environment and University-Industry Collaboration (UIC): Theories of Innovation Systems

• National Innovation System (NIS) theory was introduced by Freeman (1987) and Lundvall (1992).


• University, industry and government are identified as the main pillars of many innovation systems theories including NIS, Triple Helix and Porter’s Diamond Model.
Three levels are assumed for NIS (Wignaraja, 2003):

• The first level is made up of the industrial clusters within a country (producers, buyers, and suppliers).

• The second level consists of a set of institutions and organizations which support the learning process in industrial clusters. These institutions include: universities, financial institutions, physical infrastructure and technological support.

• The final level is the set of policies that stimulate the learning processes between industrial clusters and institutions. These policies include: political and macroeconomic environment measures, trade and competition regimes, tax regimes and legislations.
National Innovation System

National innovation system (NIS), Adapted from Wignaraja, 2003.
National Innovation Systems

- Rooks and Oerlemans (2005), the innovative performance of firms depends partly on the support of other actors in the NIS.
- External Flows into business firms can be identified. Effectiveness of any may lead to an increase in the innovative performance of industry:
Culture: An important component of National Systems of Innovation

• Important cultural norms can facilitate interactive learning in a regional innovation system. These norms include openness to learning, trust and cooperation between firms (Cooke and Morgan, 1998).

• Ney (1999) indicated the weakness of the national innovation systems account of culture, where the national differences from an empirical and theoretical perspective are not considered in the constructs of NIS’s.
Porter’s Diamond Model
The competitive advantage of nations

Critics of Porter’s Diamond Model

• Assumes cultural values and social norms have no importance other than through economic factors (Van den Bosch and Van Prooijen, 1992).

• Van den Bosch and Van Prooijen (1992) found that the determinants of the ‘diamond’ subsist in national culture, however these findings are derived from the literature and more research is recommended in order to better understand a national culture’s consequences on the competitive advantage of nations.

• O’Shaughnessy (1996) Porter’s Model does not pay sufficient attention to matters of culture and cultural dynamics which may be interpreted as a weakness. Although Porter’s framework credits national culture with a certain amount of explanatory power, he does not discuss it in depth.

• Cooke and Morgan (1993) regional development cannot be considered separately from cultural, social and institutional activities. All of these activities should be taken into account when discussing about regional development.
Triple Helix: University-Industry-Government relations

• Saad and Zawdie (2005), based on the model developed by Hakansson and Snehota (1995) argued that the spheres of government, university and industry are required to be linked through three interrelated elements to each other in order to enhance the level of learning and innovation in a specific country. These three linkages consist of:

1. The activity link (technical, administrative, commercial and other activities of an organization)
2. The resource link (availability and accessibility of resources has a significant impact on the quality of the relationship).
3. The actors link (relationships, attitudes and behaviours). As a result of these interactions, greater trust and synergy within the relationship will be generated (Hakansson and Snehota, 1995).

The third level is recognized as a pre-requisite for the success of the Triple Helix university-industry-government model (Saad and Zawdie, 2005).
A model for effective links and integration between the three spheres of the Triple Helix Model (Saad and Zawdie, 2005).
Micro-Economic Environment: University-Industry Collaboration (UIC)

- Motivation for UIC Activities

- Motivational factors: Researcher collaboration with Industry

  - Recognition and non-financial rewards are some of the major motivators for researchers to collaborate with industrial partners; benefits include promotion, better welfare, and more opportunities for grants and research funding and a better position in society (Liu and Jiang, 2001).

  - Some universities would be required to modify their rewards system in order to achieve effective technology transfer activities (Siegel et al., 2004).

  - A further source of motivation is financial rewards for both universities and researchers. Financial gains from cooperation allow a faculty to purchase new equipment, hire bright students and also reduce their teaching to enhance research (Lee, 1996; Freitas et al., 2009).
Motivational factors: Researcher collaboration with Industry

• The management of IPR and the evaluation system are salient incentive mechanisms.

• The ownership of IPR can be considered an incentive mechanism that encourages universities to look for commercial applications of their research.

• Establishing a fair sharing arrangement for royalty payments to researchers also increases their interest and commitment to the commercialization process.

• A further incentive mechanism is an appraisal systems for academics based not only on traditional teaching and research metrics, but also considers relevance of their research to industry (Debackere and Veugelers, 2005).

• Personal accomplishment and enhancing practical field knowledge are other sources of motivation of researchers for collaboration (Gerwin et al., 1991).
Trust

Formal institutions (Law, rules and regulations)

Evaluation of faculty members according to the extent of their contributions to the UIC process

Clear institutional policy on royalty sharing

Feeling a sense of accomplishment when working with industry

To enhance researcher's practical knowledge

Funding for future research

Taking new knowledge to practical application

Modify reward systems based on amount of technology transfer activities

Motivation of researchers within universities to collaborate with industry

Efficient institutional policy on IPR
Motivational Factors: University collaboration with Industry

• Lee (1996) found that universities view the value of collaboration highly if it resulted in upgraded infrastructure and grants for faculty members.

• A further benefit could be the formation of spin-off companies that financially benefit researcher and university (Liu and Jiang, 2001).

• Decter et al., (2007) identified a list of factors that motivate university-business transfer of technologies. The main ones are: royalty payments, university support to business, good publicity for the university, financial support for university research, and recruitment and retention of staff.

• Others include: enhancement of teaching, job offers for graduates, and also creating an entrepreneurial culture in their institutions (Rene and Heinrich, 2006).

• University funding cuts or decreases in funding by a Ministry of Education could be a potential external driver for the university to seek outside funding and as a consequence collaborate with industry (Laukkanen, 2003).
Increasing budget limitations for the academia

Integration into the labour market for graduated students

Recruitment and retention of qualified staff

Access to updated technical knowledge

Access to networks of knowledge creation and utilization

Access to industrial information

Recruitment and retention of qualified staff

Scope of UIC which upgrades university ranking among other universities

Access to applied knowledge with positive impact on academic research and teaching

Royalty payments to universities

Higher access to government funding if cooperating more with industry

Motivation of universities to collaborate with industry

Creating entrepreneurial culture in universities

Integration into the labour market for graduated students

Access to applied knowledge with positive impact on academic research and teaching

Royalty payments to universities

Creating entrepreneurial culture in universities
Motivational Factors: Company collaboration with Universities

- Access to new ideas and technologies that create competitive advantage, reduction in their own R&D cost, greater speed to market with new technology, recruitment and retention of staff, and access to highly specialized university facilities (Decter et al., 2007; Dooley and Kirk, 2007; Freitas et al., 2009).

- Availability of efficient IPR policy framework in universities
- Lack of in-house R&D and a shortening product life cycle
- Access to the university’s physical facilities and the expertise of its staff
- Access to the research and consulting services of university
- Improved public image in society
- Improving sales and profitability
- Increase qualification level of employees
- Creating innovation culture in their institutions
- Gaining technical knowledge
- Recruiting graduates
- Quality improvements

  (James and Casey, 2004; Lee and Win, 2004; Radas, 2005).
Efficient institutional policy on IPR

Increasing companies general technical awareness or capabilities in R&D

To accelerate or improve existing research product

Improving companies public image in the society

Increasing the qualification level of employees

Improve sales and profitability

To access and recruit highly qualified personnel from universities

Access to new technologies and process that allow achievement of competitive advantage

Ability to recruit talented students

Creating innovation culture in companies

Access to the equipped university physical facilities

Higher access to government funding when collaborating with universities

Availability of tax credit if cooperating with universities

Access to the equipped university physical facilities

Motivation of companies to collaborate with universities

Trust +/-
Promoting University-Industry Technology Transfer

• Improvements in Technology transfer processes include: a greater intermediary involvement, better rewards for inventors, better government funding of near to market technologies, greater availability of financial resources, and the availability of experienced technology transfer office staff (Decter et al., 2007).

• Availability of an appropriate organizational structure, processes and context within the university is crucial in order to channel academic R&D towards exploitation (Debackere and Veugelers, 2005).

• Decentralization is critical; universities require sufficient autonomy to develop research policies and relationships with companies. This issue is also very important inside the university, particularly with respect to giving autonomy to the TTO for developing relations with industry (Debackere and Veugelers, 2005).

• Governmental policies can encourage companies to develop partnerships with universities e.g. by providing tax incentives and funding programmes that require companies to work with universities as a condition of their funding (Rynes et al., 2001).
Technology Transfer Barriers: University-Industry

• Impediments include informational and cultural barriers between universities and firms, and insufficient rewards for faculty involvement in university technology transfer, such as credit toward tenure and promotion (Lee, 1996; Siegel et al., 2004; Siegel and Phan, in Libecap, 2005; Dooley and Kirk, 2007).

• Lack of understanding between university and industry via scientific norms and environments; bureaucracy and the inflexibility of university administrators and insufficient resources devoted to technology transfer by universities (Siegel et al., 2004).

• University institutional rigidity, fragmented organization, and the lack of mutual trust between firms and universities have been found to limit university-industry interaction in developing countries such as Tunisia (Bouhamed et al., 2009) and Croatia (Singer and Peterka, 2009).

• A cultural gap between partners also prevents trust building, which is a prerequisite for long term relationships benefiting all partners. Participation in regional networking organizations and also the presence of professional TTOs can facilitates the process of good understanding between partners, bridge the cultural gaps, and as a result increase interaction and enhance level of trust (European Commission, 2003).
Culture and Trust

• Trust is influenced by formal and informal institutions (Tillmar, 2006).

• Formal institutions are laws, rules and regulations which are defined in a national level in different countries (North, 1990).

• Informal institutions are organic and “evolve spontaneously and unintentionally over time out of human interactions, and they take forms such as codes of conduct, conventions or norms” (Havnevik and Harsmar, 1999).
Culture and Trust

Impact of different factors on trust formation:
Adapted from Doney et al., 1998.

Impact of different factors on trust formation:
Adapted from Doney et al., 1998.
Trust

Decreasing cultural differences between partners (e.g. profit maximization)

Decreasing cultural differences between partners (secrecy v dissemination)

Understanding of Partner - each other's norms

Formal institutions (Law, rules and regulations)

Informal institutions (e.g. national culture - high trust societies)

Intermediate institutions;

Communication

Values

Mission
Systems thinking is a framework developed more than fifty years ago to give a full clearer picture.

Systems thinking is a tool for understanding how things work.

It is a framework to look beyond events and scrutinise for patterns of behaviour

(Senge, 1990).
Activities in systems thinking

Balle’s (1994) introduced three activities for systems thinking:

• Focus on the relationships rather than parts,
• Detect patterns not just events,
• The use of circular causality (archetypes)

Lee and Tunzelmann (2005): the dynamism of a system depends on the availability of feedback (interaction), without which, the system is static. In systems which develop feedback mechanisms, the behaviour of an entity which includes elements, attributes and relationships changes over time.

The intention in developing a dynamic model is to understand possible feedback loops in the system. Such a dynamic model is a more accurate reflection of the real-world problem situation.
Conceptual Model

- **R= Reinforcing Loop**
- **Black Arrows= Connection between elements**

**Informal institutions** (e.g. national culture-high trust societies)

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Intermediate institutions; Relational; Individual**

- **Trust**
  - Evaluation of faculty members according to the extent of their contributions to the UIC process
  - Modifying reward systems based on amount of technology transfer activities
  - Improved political situation and Iran entry to the WTO
  - Increasing embargo imposed by West
  - Higher access to government funding when collaborating with universities

**Formal institutions** (Law, rules and regulations)

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Efficient institutional policy on IPR**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Clear institutional policy on royalty sharing**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Efficient programme which includes the mobility of people in IUC**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Activities of TTOs to support UIC including supporting of spin-off formation, and help commercialization of research results**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Support of VC**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Higher access to government funding when collaborating with universities**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Access to new technologies and process that allow achievement of competitive advantage**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees

**Creation of entrepreneurial culture in universities**

- **Commitment**
  - Trust
  - Efficiency of privatisation
  - Increasing embargo imposed by West
  - Higher investment of companies in R&D
  - Improving political situation and Iran entry to the WTO
  - Increasing the qualification level of employees
Conclusion

• Three theoretical frameworks mentioned in this study considered trust and culture as two important elements which contribute to the success or failure of an NIS in general and UIC in particular. However, there is no literature related on the mechanism for including trust and cultural forces to innovation systems, thus presenting a gap in the field of NIS.

• It is worth mentioning that although the literature (NIS, Porter’s Diamond Model, and Triple Helix’ concepts) highlight features of university-industry-government collaboration and suggest that culture and trust play a role; they lack sophistication of process models that explain the relationships.

• This incompleteness of theory leads to the suggestion that the concepts of innovation are simpler than they actually are. If the innovation concept was less complex that it actually is, then many more nations would have become advanced economies by now. However, managing the real situation requires that less tangible national assets are considered such as trust and culture.
Conclusion

• In order to create a more comprehensive conceptual framework and to better understand the complexity of UIC process, this research produced a conceptual model based on a combination of innovation systems theories with behavioural dimensions including empirically derived motivational factors, and culture and trust theories.

• According to this conceptual framework, trust is influenced by many factors including government activities, institutional structure, institutional culture, and also national culture of the country.

• The systems model is a complex interaction of different forces that emphasizes the scale of challenge policy-makers face in creating effective innovation systems, and may explain why few developing countries have been successful in achieving economic transition.
Conclusion

• Availability of effective mechanisms for UIC e.g. intermediary agents can decrease cultural differences between partners and in the long term it can enhance trust and commitment between university and industry.

• These mechanisms should be supported by government - independent from a particular institute, industry or company.

• Effective UIC contributes to business competitiveness and economic growth and drives innovation processes. This collaboration is a precondition to move towards a more knowledge-based economy.

• In order to increase the effectiveness of UIC, managing the motivational factors are pre-requisite for universities, researchers, and companies.

• Drivers (motivators) and barriers (demotivators) need to be identified in order to enhance UIC activities.
Conclusion – Systems Method

• Senge (1990) considers system thinking as a framework to give a full clearer picture of a problem situation, and as a tool for understanding how things work. It is a framework to look beyond events and scrutinise the patterns of behaviour.

• System thinking is recognised by many literature as a sound methodological approach to tackle the complexity of NIS and to better understand the relationship between different elements in NIS.

• By modelling the role of UIC in a National Innovation Systems, this research tried to fill a gap in the literature in the area of systematic behaviour models of UIC.
thank you