

INDUSTRY-ACADEMIA COLLABORATION: CONFLICTS AND STRATEGIES TO STIMULATE INNOVATION AND EMPLOYABILITY

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Abstract: *Industry- Academia relationship is an essential element to generate innovation and employability. Systematic and coordinated approaches are absent in most industry and academy relationship which brings unsuccessful collaboration among them. Current trend of relationship between industry and academia failed to impact on revenue generation hence could not able to create employment opportunity. Identify the gaps between industry and academy will allow more outcome based research and innovation. Most research collaborations nowadays are ad hoc or opportunistic based which often failed to meet the expectation and difficult to sustain in competitive world. Successful collaboration can be established if we able to recognize potential sources of conflict and ensure that they are addressed properly. In this paper we address those gaps by presenting a systematic review of the literature on industry-academy relationship. Here we investigate on areas of conflicts; suggested strategies to overcome those and identify the driving forces that can stimulate the relation between industry and academy.*

Keywords: *Industry-academia relationship, collaborative research, employability, innovative research, intellectual property, investment portfolio*

1. Introduction

The industry academia collaboration has become a complex area because of rapid growing of industry and fast changing academic world. Industry is increasing their collaboration with universities to get the newest research results and know the new innovative methods. On the other hand, universities expect that students can gather industry experience and able to convert that experience into practical fields by implementing real world research projects.

Effective and successful collaboration is a challenging task as there are lots of conflicting issues presents. Industry and academia have different objectives, cultures and working procedure. It is very hard to maintain continuous collaboration between those two groups of people. Various workshops and panels are frequently arranged to discuss the procedure of minimizing gaps between industry and universities. So, there is a need of factors that can increase the possibility of successful collaboration for both industry and academy. These factors must be managed properly to get the desired result.

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Major changes in strategic direction creates number of successful industry academy relationship which leads to many outstanding innovation in fields of science and technology. These relationships come at a very crucial time for both parties as it has the potential to create enormous impact on research. Minimizing the gap between industry and academy will allow more outcome based research and innovation which can provide real value to society.

Innovation cost has increased with little impact on revenue generation by industry if they follow the current trend of relationship. Collaborative innovation can generate revenue for industry if they can able to look outside their boundaries and intellectual properties. A successful relationship with Industry and academy can minimize the cost of innovation, generate revenue and create employability in society.

Collaborating with different areas for both internal and external activities can lead us to achieve greatest value in compare to individualistic and opportunistic based research practices. Expanding research collaboration will be able to generate benefit for both industry academy if we successfully identify the gaps between industry and academy. In this paper we investigate the nature of obstacles present in industry academy collaboration and the strategies to overcome those barriers.

2. Conceptual Background

2.1. Industry-Academia Collaboration Model

Melese et al. (2009) have discussed different models for collaboration of industry and academy. The models are based on numbers of companies and universities who are participating in the collaboration and the fund distribution process.

One company-One investigator

One company, one investigator provides an initial stage to setting up a beneficial relationship. It is a model for collaboration where an industry gives funds to only one investigator for doing research. But, in this model important person or organizations from outside are not allowed to engage themselves.

One company–One University

Sometimes an industry comes with a number of projects for a specific university and builds up an agreement with needed resources. The model builds a relationship between one company and one university. It is better for companies and universities who are in an existing relationship. But, this model constrained to the expertise and ability of only one academy. Collaborating with one organization also confines the extent of the research.

One company - Multiple universities

Another model includes one company with a group of universities. Here, an industry forms a consortium of a few universities that concentrate on a particular issue. The main benefit of the model is that universities can share and analyze their combined results from the funds provided by the company.

Competitive model

An industry provides a huge fund to a current institute or to build up a new institute. So, the company can directly access the researchers and research can easily get fund to

continue research. It is noticed that often industry people select several groups of researchers to research in same area. The group that completes the tasks first, will be provided the fund. But one of the disadvantages to this model is the group that completes first won't be best one to continue process.

"Fee-for-service" model

Fee-for-services is a model where a company is attached to a university that gives a specialize service to the company. Here, researchers can implement the abstract solution to the real world. But, problem with this model is often academic people feel that they are bound to do this work.

2.2. Benefits

Industry academia collaboration can bring loads of benefits in both sectors. According to Kathy et al. (1997) the benefits presents in industry-academia collaborations are listed below.

Industry Benefits

Cost Effectiveness

Industry-academia collaboration gives the opportunity to industry to initiate research and development (R&D) in a very cost effective way. University can provide education, training, seminar and valuable data resources with a very cost effective way. University embraces a vast source of knowledge which can be access from a collaborative project.

Resource Sharing

By a collaborative work industry can gain the intellectual properties generated by the academician. University has a strong linkage with internal and external organization and that access can be achieved by collaboration. Most of the cases universities share their resources with other university so by establishing collaboration with one university an industry can gain the support from other academic institution.

Gaining Access

Collaboration with universities supports organizations to access new methods, tools, and technologies. Industry can gain the advantage to participate on executive seminar, conference and government affiliation. University has very good relation with government which can be explode by the industry as well. Industry can explore the University-Government relationship in their collaborative works university has strong linkage with government.

Generating Revenue:

Apart from other benefits industry can also generate revenue from collaboration. By providing the access to their system industry can generate revenue from universities. "Fee for service" approach can be a very revenue generative approach for industry.

Academic Benefits

University can also draw some advantage from industry academia collaboration.

Employment opportunity

Most beneficial part of industry academia collaboration is that it can produce placement opportunity to students. Students can get internship, summer jobs and after graduation it can lead them to get a fulltime employment in industry. In many cases partner industry operate on campus recruitment for their students. University those have strong linkage with industry is an attractive place for student.

Generating fund

From the beginning industry was the source of funding for academic institution. Each year industry generates a huge number of funding to university to stimulate innovation and research. Many research labs are being sponsored by an industry. Top ranked university getting million dollar of funding from various industrial organizations to conduct their research and development (R&D). Industry also offer lots of scholarship scheme to students for their betterments.

Corporate approaches

Industry academia collaboration can lead academicians to get the access to industrial and corporate approach. The IAB was formed from industrial organization like Motorola, Lockheed-Martin, and McDonnell Douglas. IAB provide certification to university which skills and competence that should have been present in engineering institute.

3. Methodology

We represent our study and research into three (3) broad categories. Those are: 1. Areas of conflicts; 2. Strategies to overcome; 3. Driving Forces. We conduct our research and investigation in these three categories and try to generate ideas that will best suits for successful industry and academia collaboration. Figure 1 shows the three categories and their key points for generating successful collaboration between industry and academy.



Figure 1: Investigated three categories and their key points to generate successful collaboration

4. Areas of Conflicts

4.1. Intellectual Property and Ownership Right

The most traditional conflicts between industry and academy are lies in intellectual property rights and ownership. To protect proprietary information both university and industry make agreement to protect their intellectual property and make publication delay to allow company to get the ownership right. Intellectual property rights often goes against of innovation and research as restriction on sharing information leads one side completely unaware of invention of others.

According to Melese et al. (2009) one of the most conflicting areas between industry and academy is the open access of data. Most successful collaboration models does not consists open access to data and does not allow sharing of resource to others. This protective approach may create successful collaboration but also creating limits in innovation and research. Sharing resources and information are generally a norm and culture for universities whereas it is against business practices for most of the companies. Valentin et al. (2007) has discussed that the previous practice transferred rights of invention to only industry people.

It will be challenging for academic researcher to contribute on innovation if the intellectual property terms are too broad. If the restrictions are set too high it might happen that after the collaboration ends continuation of that research may not possible anymore. Unnecessary limit or tie will then become major barrier to innovation and leads to an unsuccessful collaboration. Increasing commercialization in industry academic relation creating more patenting research but quality does not improve in that level.

Bayh-Dole Act suggests that since the early 1980s, the patenting level of university increased significantly but the quality of those patents declined ominously as well. (Melese et al.2009). It was found in research that increase in university patenting has slowing down the progress of joint collaborative research project (Valentin and Jensen, 2007). Collaboration that only focuses on commercial benefits often led to substantial distributional conflicts between universities and industry (Florida, 1999; Shane and Somaya, 2007).

4.2. Differences in Culture, values and norms

There are significant differences in culture, values and norms present in industry and academia. In university researchers have all the freedom to set their goal, timeline and objective whereas it is set by the authority in company which most of the cases are not flexible. So there are clear conflicts of culture, value and norm among industry and academy.

According to a review of the literature on university–industry relations we have found that individual determinant ‘male’ plays a positive impact on engagement (Perkmann 2013). As per their research males have comparatively distinguished position and broad network compare to woman (Perkmann 2013) (Etzkowitz 2000) (Gupta 2005) (Murray 2007). Another determinant ‘seniority’ effects positively in the aspect of engagement due to their numerous social capital. Moreover they can get more governmental grants and has more publications (Perkmann 2013).

The company and university have different goals and judgment procedure. Universities don't provide any academic reward for interaction with industries. Maximum researchers are not interested to do development on R&D. Sometimes researchers produce an abstract result that can't be implemented in the practical field. One of the main challenges discussed by Gorschek, Tony, et al (2006) to start collaboration with industry is universities don't understand the present industry practices or requirements. As they don't know the current needs, research output will not be well fitted to the industry context.

Industry and academy follow a different timeline during the planning of research projects. To fix timeline, research project should fix the goal. This mismatch is challenging because often research takes the lengthy process to solve more innovative problems. On the other hand, Jain et al (2013) declares the industry has a short-term goal to deliver products.

4.3. Financial Management

Another constraint of industry academy relation is financial management. To pursue research on different aspects most academic researchers pursue and acquire multiple source of funding. To generate innovation and employability the level of funding must be adequate to support staffing and other expenditure for academic institution. In other hand companies need to balance their investment to meet their goal and demand.

Most companies provide fund in academic research to get the access to intellectual property which may difficult from their perspective. Without much expectation most of the funds are provided to the academy for research and innovation purpose. But nowadays most company invests strategically so that they will get something in return. Most academicians have lacking on financial management and industry people are very much proficient in this sector. It is always remain a challenge for academician to manage the fund properly to satisfy their investment partner.

4.4. Project selection and publication

One of the conflicts between industry and academy is the attitude towards the topic selection and publishing the result. While researchers from academy tend to publish their research outcome, industry may wish to keep the outcome secret to gain the advantage from other competitors. Brown and Duguid (2000), describe the approach of sharing information by academic's are "leaky" and approach from industry are "sticky". In terms of research topic selection academician select or tends to do research on topics that seems to be interesting and valuable, in other hand industry choose topics that will bring financial benefit and keep them ahead from other competitors (Nelson, 2004).

4.5. Miscellaneous

According to Guan (2007) some other conflicting issues are:

- Academician spends their time in some aspects that has a lower priority in other countries. This decreases the demand to the industry.

- For the demo implementation many researchers use immature technologies due to lack of relevant technologies/instruments. Then industry feels a lack of interest to implement.
- Market demand is not reflected in many researches. It slows down the implementation and collaboration.

According to Siegel (2003) we have found some more conflicting issues like:

- Administrator has a lacking of skill in the aspect of marketing, negotiation or technologies that is the barrier to the collaboration between academia and industry.
- In addition to there are a small number of government program in almost all countries that supports the interaction between industry and academia.
- Unrealistic expectations from industry

5. Strategies to mitigate the conflicts

5.1. Establishing new attributes in intellectual property and ownership rights

Innovation and ownership rights both can be achievable if more thoughts given to structure the contractual agreements. It should be clearly define what knowledge can be share and what knowledge requires protection for business perspective. To stimulate innovation industries have to take certain amount of risk in collaboration. If we able to make sure that for every investment there should be some return for both parties than a successful collaboration can be made. Most of the universities are limited by laws in term of intellectual property and ownership rights. If both parties are willing to convey then mutual benefit can be achieved apart from this constraints. (Melese et al.2009)

To cultivating innovation a better approaches and attitude need to be impose in terms of sharing information. Restricted behavior in sharing information will never going to be produce significant innovation and research. To protect the returns on their investment most companies nowadays rely on making patents to all information whether they will create value or not. Restricted sharing can only effectively blocks competitors but hamper innovation and collaboration. It may happen that researchers often engaged in research that already conducted by others. According to Melese et al. (2009) classifying information into two categories (proprietary and nonproprietary) will be a best approach. Proper classification and understanding of those two categories among both parties can be a solution. By doing this companies can share nonproprietary information with academic researchers without fear of losing revenue and ownership right thus can stimulate innovation and employability.

For proprietary information it can be subdivided into two groups which should be safeguarded and which can be share. By this company can sell their less important proprietary information to others in market value and others could be beneficial by this. Information that may give competitors an advantage should delay to publish until it becomes safe for the company to gain their advantage. But it should be kept in mind that research information is a variable that depreciate over time so keeping the information without sharing will be self-distractive. (Melese et al.2009)

5.2. Develop new approaches on culture, values and norms

It is essential to understand that there will be difference in culture, values and norm and which is very much acceptable. To develop a successful relation both parties need to stand on their own ground respecting each other culture, value and norm. Nowadays companies appoint investigators for their project funding. Investigators are responsible for creating a budget and for decision making of continuation of that project. To meet the corporate budgeting expectations academic community need to introduce new concept and strategies to align with them. Academic researchers have to admit that companies have much more expertise and resources to access the system and framing the budget.

5.3. Considering the collaboration as an investment portfolio

To make successful industry academy collaboration we need to consider the relationship as an investment portfolio. To avoid duplication most companies currently choose external collaborators to look after their investment in research field. But it also creates difficulties among industry and academy on decision making. Treating industry academic collaboration like an investment portfolio will help to documentation, define the opportunities and ensure that they are visible to everyone. Traditional industry academy relationships in most cases are person dependent and failed to ensure proper management of the project. Every investment portfolio has some strategies to sell their product. Therefore the outcome from a research will get more evaluation.(Melese et al.2009).

Considering every research projects as an investment portfolio will help to exclude redundancy and capitalize the most out of a research project and managing multiple research projects without any conflict of interest. For instance, nanotechnology has application in both oncology and diabetics. Investment portfolio will help to develop a master agreement with industry and academy to cover all the collaborations that company will be associated with. It will create awareness of existing collaborations across department, campus, universities and companies. In return it can significantly eliminate the redundancy and help other researchers to collaborate with. It can also encourage internal university research groups to work collectively and share resources among each other which may not be possible without an investment portfolio.

Investment portfolio helps in major and repeat collaborative works by increasing the level of collaboration between industry and academy. If we able to provide a secure interface then participating organization will be able to share knowledge, data materials and other resources which will stimulate innovation and research. A common vision between researchers with business development is primary requirement to establish a master agreement between industry-academy collaboration. (Melese et al.2009)

5.4. Introduction of new schemes and model

New business schemes need to be imply which will create open innovation research networks that promote value creation instead of develop barriers for competitors. 'Open Strategy' model should be introduced where balancing with industry interest open innovation will be encouraged. Value capture and sustainability will be the challenges for this new model which can be overcome. In this model companies will designate a sector to all academies and industry to research collaboratively by just providing service basis payment. (Melese et al.2009)

By creating this model one organization can able to accomplish their information more efficiently and can stimulate more innovation and employability. Rather than sticking with one research project for a long time this model can help make alliances in different project successively. Such initiative can open the door for other researchers to contribute and redundancy in research can be minimized. It can also overcome the drawbacks of sharing information with associated researchers and create new opportunities for researcher to generate new ideas. By sharing resources among each other the technology gap can be reduce as well as standards and protocol issues.

5.5. Creating proper value proposition

We are in tipping point in terms of innovation, research and employability and to overcoming this situation we need to reach across our organization. The ability of companies to gain profit from their investment diminishing as research and development (R&D) cost rises significantly. Creating proper assessment will be beneficial for both parties. It is fundamental need in successful collaboration. How they evaluate the value of their resources (expertise, knowledge, and data) in compare to their partner and evaluate the new value and innovation on investment in collaboration will need to be address properly.

Collaboration that could be productive or not cannot be easily determine beforehand but it is possible to create new strategies and infrastructure that optimize the potential for success. If flexible and equitable collaboration cannot be made in their approach to valuation it will be impossible to stimulate innovation and employability at any means. Most of the companies place the most value on invention that can provide profit on their investment or can be applied to real world problem whereas academician gives values that will increases or stimulate the depth of knowledge. It is important to realize that you can only able to achieve innovative solutions to real world problem if you have the depth of knowledge on that problem. So as both university and industry have common goal we can easily create a value proposition out of it that can lead us to create a successful collaboration among university and industry. (Melese et al.2009).

5.6. Implementation of agile methodology

Sandberg et al. (2011) suggested that the research project should adopt changing requirements like real life industrial projects. In order to produce better result projects have to respect and agree with new changes. The research project can be easily managed if agile method is followed. Projects can use incremental and continuous process to deliver research result, instead of following big bang process. Developing short-term goal, following iterative methods, integration flexibility will help to enable agility in research projects.

5.7. Effective project management

Baldassarre et al. (2014) recommended that the collaborative project should be planned carefully and need nurturing. A good model of collaboration must be followed to be successful. The perfect time for beginning the coordination must be considered. Both sides must be aware about their timeline during the agreement. The both groups must choose best employees and researchers to start collaborating. Researchers should be motivated to do development also.

5.8. Best Practices

For industry Siegel et al. (2003) suggested some best practices that might improve the industry-academia collaboration:

- To minimize the cultural gap between industry and academia industry should be proactive, positive and practical.
- When an industry need a technology expert then they should contact with experience researcher or faculty from the university.
- Industry should try various ways to be connected with different organizations rather than stick with one organization.

For University Siegel et al. (2003) also suggested some practices that should follow:

- Academic people should increase their knowledge about the actual needs of customers. Here customer means the firms as the developed technologies will be commercialized by the firms.
- To do the above task if the agreement is negotiable then it will be helpful. Moreover if all the policies and procedures of official contract are easy and flexible then it will help to get effective integration of universities and industry.
- In this context, researchers can take help from officers who have valid license and more experience.
- To do a specific task or meet a specific vision, related or concern managers/administrator of research should be selected.
- Rewards are always helpful to inspiration. So for the participation of the faculty, if the rewarding practice is introduced then it could be very effective. Rewards can be valuating patents or revenue or promotion etc.
- Now a day social networking is very popular to use is all aspect. If we maintain personal relationship between scientist, alumni and faculty then it can be helpful.

6. Driving forces that stimulate successful collaboration

6.1. Experience

Experience plays a significant role in industry academia collaboration. To manage a collaboration an operating routine and practice should be followed accordingly. But in some cases it may happen that those routine or practice may not work in one project but works in another. So refined and reuse of concept can be applied where it may suited. A successful collaboration often comes from experiences as both parties learn how to refine and develop relationship in different stages. These experiences converge in attitudes, norms and culture to build better understanding among each other. Experience in collaboration helps both parties to set the goals and reduce the barrier related to research orientation.

Successful academia-industry collaboration requires expert and skilled people. Sometimes researchers may have lack of practical experience. The researcher must have knowledge about company context. Otherwise, it will be difficult to deliver relevant information to start a project and find appropriate solutions. It can also help to lower the transaction related barriers in collaboration. Collaboration experiences are one of the critical determinant factors which define how successful collaboration can be achieved. According to Hertzfeldt et al. (2006), proficient collaborators use standard protocols for negotiations on intellectual properties ownership. To securing the good will of partners creation of acceptable rules of patent is instrumental for successful research collaboration (Hertzfeldt et al., 2006);Jelinek and Markham, 2007). Companies that have experience in many projects may have greater conveying capabilities with industry partners. So it can be expected that experience in collaboration should help to minimize or lower the transaction-related barriers.

6.2. Project Selection

Project or topic selection is an important task in the early process. The present problem of industry must be well understood to choose the right topic. Successful collaboration needs regular meeting and seminar of industry experts and researchers. These meetings should output important and relevant topics. Which project should get highest priority need to be identified properly. Prioritization of project is a key to success and essential to become a market leader. Some systematic method can be used to select right topics or projects on right time.

6.3. Interaction

Interaction has played a key role in industry academy relationship. We have to admit that both industry and academy have practices different culture, norm and values. These gaps or differences can be minimized through interaction. In most of the cases industry and academy engaged with each other in form of research collaboration, consultancy work, meeting and conferences. To establish a successful collaboration out of those interaction other broad interaction in different channel should be introduce. High levels of coordination and sustained interaction will offer rich opportunities to exchange knowledge among each other.

Successful collaboration requires continuity and end-to-end communication. So, communication gap can be a big challenge. One of the main causes of this gap is that both researchers and practitioners use different terminology. Petersen et al. (2014) find the reason of this problem is deficiency of common and standard terminology list. It will also create opportunities to learn and understand the cultural differences for both parties. Short term interaction may not require

dignified contractual relationship but for improving the effectiveness a formal long term research agreement must be there which can be achieved by broaden the interaction in different channel (Kogut, 2000). Therefore, interaction in a wider range with university may enable the conjunction of approaches and helping to overcome obstacles that are present due to differences in culture, norm and values.

6.4. Trust

For Industry university collaboration there are high levels of uncertainty which create trusting issue a key factor for a successful collaboration. It is an impossible task to predict a research project will be viable one or not or it can produce commercial benefit or not. Only high level of trust can make sure to diminish the doubts that partners will act deviously (Bradbach and Eccles, 1989; Dodgson,1993). How collaborator will treat each other in a consistent way and will understand and resolve any situation is depends on how they trust each other. Trust is a very key factor of university-industry link as they often required sharing sensitive commercial information and knowledge (Santoro and Saporito, 2003). With a low level of trust one cannot expect a successful collaboration as both parties will be conscious of sharing information with each other. So it can be expected that high level of trust can be a solution to overcome both oriented and transaction related barriers.

Figure 2 shows the driving forces that stimulate innovation and employability through successful collaboration.



Figure 2: Driving forces that stimulate successful collaboration

7.0. Recommendation

We investigate on different models, areas of conflicts, strategies to overcome those conflicts and driving forces. From this investigation we present a recommendation that might work on establishing successful collaboration among industry and academia. For each industry-academia collaboration model table 1 indicates what are the conflicting areas, strategies to overcome and driving forces for successful collaboration.

Table 1: Recommendation on successful collaboration

Model	Areas of Conflicts	Strategies to overcome	Driving Force
One company - one investigator	1. Intellectual Property and Ownership Right 2. Project selection and publication	1. Establish new attributes in intellectual property. 2. Creating proper value proposition	1. Interaction 2. Project Selection
One company – one university	1. Intellectual Property and Ownership Right	1. Introduction of new schemes and model 2. Effective project	1. Experience 2. Project

	2. Financial Management	management	Selection
One company – multiple university	1. Differences in Culture, values and norms 2. Financial Management	1. Develop new approaches on culture, values and norms 2. Considering the collaboration as an investment portfolio	1. Interaction 2. Trust
Competitive model	1. Project selection and publication 2. Miscellaneous	1. Creating proper value proposition 2. Implementation of agile methodology	1. Trust 2. Experience
Fee-for-service model	1. Intellectual Property and Ownership Right 2. Financial Management	1. Effective project management 2. Introduction of new schemes and model	1. Interaction 2. Project Selection

8. Conclusion

To stimulate innovation and creating new employability a successful industry academy relationship have an important role. And for creating that relationship we need to consider what are the gaps and conflicting areas are present and what will

be ways to overcome those obstacles. Collaboration will be not enough to generate innovation that will make a great leap forward. We need to introduce new model new strategies and precompetitive research where there will be no barrier of information sharing and every research project will be treated as an investment portfolio.

Significant challenges are present in industry and university collaboration. Private firm or industry focused on generating revenue from their research investment whereas universities are focused to create new knowledge and educate others (Dasgupta and david, 1994). To create valuable intellectual property to stimulate technology transfer universities are nowadays become very much proactive with their industry collaboration. As the interaction between industry and academy increases significantly more formal, contractual and coded rules and regulation implied. Before any policy making what are the barriers are present and how to mitigate those should have considered first. Without proper mechanism of overcoming with those barriers no collaboration will be succeeded.

To develop our economy we should not emphasis on a single term of revenue. We should put strong concern on entrepreneurial start-ups, various capital schemes and intellectual property. If we want to encourage innovation then the relationship between university and industry should be strong. On the other hand if the innovation exists then proper implementation should be introduced. Employability helps to faster the process of implementation and collaboration. We have found that there are a lot of barrier to establish a sophisticated interaction between industry and academia.

9. Future works and Limitations

In future we will try to investigate all of the collected ideas in real life situation. We will conduct survey in both industry and university to generate report that will best suit. It will also help us to know the feasibility and limitations of our approach. Moreover in future we will try to collect more data and successful ideas that will accelerate the relationship between industry and academia. As an experimental base we can recommend a model to both industry and academia to implement to see the outcome. In future we also want to represent the "Triple-Helix" concept where industry, academy will collaborate with government for stimulating innovation, research and employability.

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