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Customer Adoption of Internet Banking in Mauritius

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Abstract

Internet banking offers many benefits but little research has been done about its acceptance in Mauritius. This paper aims at assessing the factors that contribute to the adoption of internet banking in Mauritius. To support our arguments, we use a logistic regression model based on a sample survey to analyze the factors that influence internet banking in Mauritius. We conclude that factors such as age, income, service usefulness, risk factor, checking account frequency and internet location are the main determinants for a person to opt for online banking.

Keywords: Internet Banking, Factors, Logistic, Regression Model.

1. INTRODUCTION

Mauritius can be considered to be one of the safest places to bank, invest or establish a fund trust as it is economically and politically stable with good law and order appliance. The presence of the Banking Act 2004, the Finance Act 2004 and the Financial Services Act 2007 confirms the reliability of the banking sector of the country. The Bank of Mauritius as the Central Bank, licenses, supervises and regulates the banking system. Mauritius is said to be regional financial center with 19 licensed banks where the majority of which are foreign-owned locally incorporated banks or branches of foreign banks. The increasing business flow in Mauritius and a booming Global Business sector banks have helped to urge innovation in terms of products and services in order to keep pace with new client's requirements. Internet banking is one of them. Shih and Fang (2004) describe internet banking as a new type of information system that uses the innovative resources of the internet to enable customers to effect financial activities in virtual space. Customers enjoy self-service, freedom from time and place constraint, and reduced stress of queuing in banking hall. Customers can reach a given institution from literally anywhere in the world. In fact from any location where there is internet accessibility, users can conveniently and quickly use online banking. There is perfect information available to all market participants which brings efficiency in the banking market and dismantles the oligopolistic market of the banking sector this alleviating the market towards a perfect competition one. There are three kinds of internet banking that are currently employed in Mauritius and these are: Informational, Communicative and Transactional. Informational internet banking which is the most basic level of Internet banking and first level of banking is about the marketing information about the bank's products and services on a standalone server and provided by four banks in Mauritius.(Barclays, Bank of Baroda, Deutsche bank and Pt bank international). This level of Internet banking service can be provided by the bank itself or by sourcing it out. Thirteen banks (MCB, SBM, SBI, Bank One, MPCB, Banque des Mascareignes, Standard Chartered Bank of Mauritius, Afrasia, Hsbc, Standard Bank and Investec) allow the following two other types of internet banking which are communicative transactional and advanced transactional internet banking websites. The organization of the paper is as follows: In section 2, we consider the factors influencing the

internet banking. In section 3, we present the logistic regression model and the results. The conclusion and recommendations are presented in the last section.

2. FACTORS INFLUENCING INTERNET BANKING

Researchers (Dickerson and Gentry, 1983; Mattila, Karjaluoto and Pento(2003) Zeithaml and Gilly, 1987) considered demographic variables to be important. Karjaluoto et al. (2002) showed that occupation was a significant factor for adoption of internet banking. (2003). Sathye (1999), Liao and Cheung (2002) and Polatoglu and Ekin (2001) found that the reliability dimension was an important determinant for consumers who used electronic banking. Additionally, Munhurrun and Naidoo (2008) findings revealed that reliability and security was perceived as the most important dimensions in internet banking transactions that influences satisfaction and behavioral intentions. The more people feel secure, the more they will adopt internet banking. According to Cooper (1997) and Daniel (1999) the factor affecting the acceptance and adoption of new innovation is the level of security or risk associated with it. An empirical survey by Sathye (1999) of Australian consumers confirmed this fact and Ho and Ng (1994) and Lockett and Littler (1997) empirically support that the use of electronic banking involves risk. Johnson et al (1995) and Chan (2001) stated convenience as one of them as one of the adoption factor. Baldock (1997) found that the implementation of internet banking would remove the constraints of time, place and form. Birch and Young, (1997) asserted that consumers would also enjoy the privilege of access to far more providers of banking services. Ma¨enpa¨a (2006) find seven dimensions of internet banking services which are convenience; security; status; auxiliary features; personal finances; investment; and exploration and also examined that customers using internet banking could be divided into four clusters namely their needs, behavior, age and education.

3. ESTIMATION OF PARAMETERS AND INTERPRETATION

In this section, we present the statistical model used to analyze the factors that influence internet banking. We have initially collected data based on a sample of 1240 interviewers. Since the variable of interest is whether a person adopts online banking or not, that is binary, we adopt a logit link specification based on the generalized linear regression model where

$$\ln \frac{p_i}{1-p_i} = x_i^T \beta$$

where $p_i = P(Y_i = 1)$ indicate that the i^{th} person has opted for online banking and $(1-p_i) = P(Y_i = 0)$ signify the person has not adopted online banking. The vector of explanatory variables for the i^{th} individual constitute of the intercept term, the age of the person, the level of income, the area of residence (1 for urban and 0 for rural), the perceived risk (1 for internet banking is risky and 0 for not risky), the usefulness (1 for internet banking being useful and 0 for not useful), the frequency of assessing bank accounts, the type of person (1 for risk-lovers and 0 for risk-averse) and internet location(1-Home, 2-Work, 3-Mobile or similar devices,4-elsewhere and 5- no internet).

Variables	Estimates	Standard Errors
Age	-1.589	(0.5627)
Income	2.3669	(0.6053)
Area	0.3670	(0.8413)
Risk	-6.522	(1.8660)
Usefulness	5.1411	(1.1100)
Frequency	1.3520	(0.3797)
Type of Person	-1.4581	(1.0591)
Internet Location	-2.1091	(0.5022)
Constant	2.2710	(2.1812)

Table 1: Regression Table

Generally, the model fitted the data well. The likelihood ratio chi-square 47.60 with a p-value of 0.0000 tells us that the model as a whole is statistically significant, as compared to model with no predictors or an empty model. The pseudo-R-squared is present as we are using a non-linear model and due to the non-direct equivalence of R-square which is in ordinary least square models. We see that the variation caused by the various independent variables have impacted on the dependent by 0.8517. We do not consider demographic variables such as gender, area of residence and marital status since they have been found to be insignificant as demonstrated in by Padachi et al (2007) and Tandrayen-Ragoobur (2010). Among the factors we consider, we note that the type of person whether he is a risk-seeker or risk-adverse person is also insignificant but this variable has indeed influenced how the person perceives internet banking. Age has been a significant factor in the survey if we consider p value significance at 0.05. The negative coefficients 1.589285 demonstrate that as people tend to be older, they tend to not adopt Internet Banking. Considering the senior bank customers are more risk averse and they prefer a personal banking relationship rather than a machine-generated one. Instead, young customers are more dynamic to do all the formalities and adopt Internet Banking and conduct their transactions. Another reason for that is greatly due to mobile phones top-ups which is a popular service among the younger population conducted through internet banking. So the regression did really abide by the logical belief would be that the younger people are more prone to adopt new technologies as internet banking. As income increases, it is shown that people are more likely to use Internet Banking by 2.36669 unit change in the log of the odds which was in contrary to developed countries where high income earners were less likely to adopt Internet Banking as they preferred a personal contact towards the staff due to big transactions. Here in a developing country, this shows that as people get more earnings they are more prone to adopt technologies to do their banking privately and on their own. Moreover, higher income earners are more able to access internet connection and thus internet banking. The risk factor (financial risk, social risk, performance risk, time risk) about internet banking seems to negatively affect the probability to adoption by 6.522081 unit change in the log of the odds. This may be attributed to perception and another variable in the study which is type of person whether the bank customer is a risk-averse or risk lover. Moreover, for the usefulness variable, we find a very significant positive relationship of 5.140606 unit change in the log of the odds. This actually refers to how bank customer perception about internet banking as a useful technology in terms of ease of use, cost and time efficiency, user friendliness. This means that the more bank customers find internet banking to be useful, the more they will adopt it. Additionally, all respondents have stressed on the idea that internet banking saves time as the priority reason to make use of this service and consequently that banking can be done whenever it is convenient. The frequency variable is quite significant. This signifies that the more the bank customer checks his account per month, the more he is likely to adopt internet banking. This is so because of convenience as the customer would not have to lose time, money and energy resources to check his account in a branch or ATM. For example, customers checking their account more than 12 times find it much easier to log into the website than to physically go to the bank. Many respondents find the reason to use of internet banking is due to the 24-hours internet availability. Internet location had a negative impact of 2.109156. This demonstrates that internet location has an overall negative impact on internet adoption. Internet location was individually regressed and we see that internet at home had a positive impact and internet at work had a negative impact. Furthermore, no internet definitely has a high negative effect as evidently if there is no internet, there is no internet banking.

4. CONCLUSIONS

A logistic regression is used to regress from the surveyed data of 1240 customers and we conclude that six explanatory variables namely age, income, risk, usefulness of internet banking, frequency of checking bank accounts and internet location are significant. In our developing economy, demographics such as gender, area of residence and marital status have been insignificant in this case unlike in developed countries. Mauritius has a well-developed banking sector but it has lagged behind in terms of internet banking. This can be due to lack of information

as we have remarked that non-adopters of internet banking are quite ignorant about this service as they prefer branches or ATMs; prefer personalized service with social-related counters; perceived tedious formalities to have an internet bank account or simply lack of funds. The last reason is due to many economic attributed reasons where bank customers simply do not seem it having any value as they do not have enough money or simply prefer using cash and cards. Moreover, although banks have security arrangements such as network and data access controls, user authentication, transaction verification, virus protection, privacy policies and detection of possible intrusions which include penetration testing, intrusion detection, still bank customers still beware of possible risks from internet banking. Last year's advent from e-filing payment for MRA where tax payers can file their returns electronically by 5 banks has greatly helped to boost up internet banking. Banks should implement more marketing strategies to enhance internet banking usage and educate the public, especially low and middle-income earners and higher aged people more about the benefits of this service and make available more computers and qualified staff to explain about the different bank formalities and websites. Compared to previous studies, we have not considered demographic variables as they were found to be insignificant. So far, our binary regression model has provided a good insight about the factors that may influence internet banking and has also yielded reliable estimates.

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Designing of Success Criteria-based Evaluation Model for Assessing the Research Collaboration between University and Industry

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Abstract

Innovations and inventions are not outcomes of single activity of any organization. This is a result of collaboration of different partners. Collaborated research of university and industry can enhance the ability of scientist to make significant advances in their fields. The evaluation of collaborated research between university and industry has created the greatest interest amongst the collaborational researchers as it can determine the feasibility and value of the collaboration. This paper intends to illustrate the evaluation metrics and success criteria- based evaluation model within university-industry and their collaborated research. For bridging the model, success criteria that is based on key evaluation metrics has been identified. A successful Collaboration of university and industry is not dependent on any single metric but instead on the confluence of multiple metrics from the growth of basic research to commercialization. This study is intended to provide different evaluating metrics to impound the research collaboration constraints between university and industry, and to design success criteria to upsurge the successful linkage. For this purpose, we have developed constraints and success criteria based evaluation metrics (CASEM) model. The proposed model is appropriate for almost all types of collaborations, especially research collaborations between university and industry. By adopting this model, any university or industry can easily cross the threshold in the grown-up research collaborational community.

Keywords: University Industry Research Collaboration, Evaluation Metrics, Evaluation Model, Technology Transfer, Success Criteria

1. INTRODUCTION

The accelerating antagonism in consumer as well as the commerce world is forcing industry to discover the new ways to promote product and service innovations. To increase the number of

fundamental innovations and for the technological development frequent collaboration and cooperation of university-industry is crucial. The importance of university-industry research collaboration has risen steadily as a consequence of growing complexity, risk and cost of innovation. The improvement in the relationship between science and technology, the integration of science and industry, the appearance of industries based on science, the use of science as a means to produce competitive advantages on the part of the firms, as well as the globalization of the economy and internationalization of technology, are some of the reasons which justify the cooperative relationship strong collaboration between firms and research organizations [1]. National economies somehow depend on research implication, that's why most of the nations reserve big amount of their annual budget for their education especially on research aptitudes. A very huge number of research activities every year is going on in all developed and developing countries, but all the researches are not commercialized thus leaving some weaknesses on the university-industry collaboration (UIC).

For the evaluation of university-industry collaboration and for the maturity of any nation's technology transfer are no doubt very important and a powerful means discussed by practitioners as well as by scholars [2]. University research centre is one of the most attractive external sources of technology for the industry, in an industrialized country; there exist a strong collaboration between university and industry to facilitate the exchange of technology [2]. The mere presence of traditional economics inputs of land, labor and capital is no longer enough to ensure economic growth in a nation. What is now important is the rationale application of these resources to productive purposes by means of technology. Both the industrialized and developing nations recognize the fact that university- industry research collaboration plays a significant role in economic growth and the improvement of living standards of their countries. It is widely acknowledge that transfer of technology has played a key role in the economic and industrial development of any nation. Despite the great importance of university-industry collaboration, there have been some major constraints in successful collaborations. Therefore it is necessary for the developing countries to promote the relationship between university and industry and should also identify and improve those elements in which they are weak, such as developing an appropriate industrial and technological infrastructure. As the matter of fact, the first generation of any commercialized product in infancy stage is always incubated in research center and the final place just before commercialization is R&D of industries. University research is normally education based but industry demands commercial based research, thus most of the research seems to be useless and shelved in the library for the references leading towards the wastage of resources every year [1]. To avoid such problems, we need strong collaboration. Periodically, evaluation of the research collaboration is also one of the key steps to strengthen the linkage. However other important techniques should also be adapted to develop their existing collaboration.

This paper is organized as follows: section 2, describes related work Section 3, presents the Research Method Section 4, CASEM Model, In section 5, key evaluation metrics with their success criteria, In section 6, Performance analysis which is followed by conclusions and future works.

2. RELATED WORK

The idea and concepts associated with university-industry partnerships are not new and it is commonly agreed that universities are an important source of new knowledge for industry [2]. The perspective of the university as a key contributor to wealth generation and economic development [3] has increased in recent decades. The author of [4] states that academic research has become "indigenized and integrated into the economic cycle of innovation and growth". Within the current knowledge based economy, the university acts as both "a human capital provider and a seed-bed for new firms" and innovation [5]. In the USA some of the most prestigious universities (e.g., MIT) were established more than one century ago to support close research relationships between university and industry (U-I) [6]. The partnership (U-I) has been considered as one of the main factors contributing to successful innovation and growth in the past two decades [7]. There is plethora of research studies on identifying and analyzing cultural, technical, legal and macro-

organizational factors governing the success of U-I collaboration [8]. To increase the number of fundamental innovations and for the technological development frequent collaboration and cooperation of university-industry is crucial. Successful cooperation between university and industry requires special kind of synergy. In this manner huge number of studies has analyzed the interactions between the firms and research organizations that generate knowledge and enable firms to transform it into tangible forms applicable by country. Several papers have examined the relationships among university, industry and government agencies the so-called triple helix metaphor [9]. Some authors focus on the technological progress, some focus on the characteristics and their culture; most of the author addresses the implications of the metaphor in the context of regional policy [10]. Some authors have tried to write the role of academic organization on the development of economy based on the product development [11]. Some author focus on the motivation highlighting the collaboration [12].

Many more studies has been analyzed about university-industry knowledge transfer and their technological collaboration[13], [19] and up till now new research is going on to make this collaboration stronger as this collaboration is crucial by social, economical, educational, industrial as well as political point of view. Unfortunately a few numbers of researches has been attempted for the assessing of research collaboration. In this paper, we have focused mainly on evaluation metrics and success criteria to evaluate university-industry research collaboration and proposed CASEM model that can be significant for all sorts of collaboration specially research collaboration. For this purpose, we have investigated all the major constraints that always are a conflict between these two important partners. At the end we have demonstrated the outcomes or outputs that are the consequences of the best collaboration, and it shows the strength of their relationship.

3. RESEARCH METHOD

To achieve the best success criteria of university-industry research collaboration, in the beginning we proposed two types of research questions.

1.What are the constraints and tangible outcomes associated with establishing and maintaining research collaboration between university-industry?

2.What are the evaluation parameters need to take in consideration to evaluate the strength of research collaboration?

The first question aimed to explore the constraints and impeding factors which are commonly associated with establishing and maintaining research and technological links between university and industry. This research question seeks to describe the phenomenon and describe the cause and effect between the phenomenon of university-industry links and a range of proposed factors. The second research question seeks to identify the existing parameters for the evaluation of university-industry collaboration. For this purpose some evaluation metrics already proposed to the respondents to choose appropriate key metrics. In order to collect reliable information about the university-industry research collaboration and their success criteria, a comprehensive questionnaire was developed in order to get the detail description. For this purpose, the selection of the respondents was the most challenging part of this research. After a long decision process, our key respondents were the fresh PhD graduates, final year PhD students and research officers from the “Research centers and Centers of excellence” have been selected from the universities and actively participate with the industries and they have old experience of university-industry collaboration.

Second step was to develop the questionnaire. For this purpose, we developed both type of questionnaires quantitative and qualitative. The quantitative questionnaire was comprised of 60 questions. Respondents were asked to rate each request on a scale from 1 to 5 with being strongly disagree and 5 strongly agree. To develop the survey questionnaire we conducted a number of interviews with different research centers of the university that have strong research alliances with their collaborated industries as well as reviewing the literature. In the survey, the

questionnaire has been developed about the constraints between university-industry collaboration, evaluation metrics and success criteria to make this collaboration stronger and also created a separate portion for the corresponding tangible outcomes of success criteria. The process of data collection was completed in different stages with different modes. Our most concern was face to face data collection which is done by structured interview and almost all the respondent interview even for quantitative collection to get more and more reliable data and to minimize the chances of missing data. For ensuring the reliability of the data, we have conducted a number of tests like in the interviews, the reliability increases if the same question is asked more than once in a similar way with different respondents and similar response prove the validity of sample and data.

Moreover, we have compared the quantitative and qualitative data and we found very slightly difference in both of them that shows the data is reliable. Finally after the data gathering through our successful survey, the data has been analyzed to recognize the success criteria of university-industry collaboration. The survey was very helpful for the development of evaluation model for university-industry research collaboration.

4. CASEM MODEL

In our proposed CASEM evaluation model, the success criteria are directly or indirectly based on core limitations and constraints of university-industry linkage via evaluation metrics. To evaluate this linkage our key concern is to finalize the main constraints by using qualitative and quantitative data as well as secondary data collection to finalize the constraints. Once the constraints are tested we will again use above mentioned data collection scheme to finalize the evaluation metrics. Success criteria will be described for evaluation metrics and the result of the evaluation metrics will be compared with the tangible outcome. If the comparison shows almost all the same parameters then we can say the type of collaboration is stronger.

Our model comprises of five steps.

1. Constraints
2. Evaluation Metrics
3. Success Criteria
4. Tangible Outcomes
5. Comparison of Success Criteria and Tangible Outcome

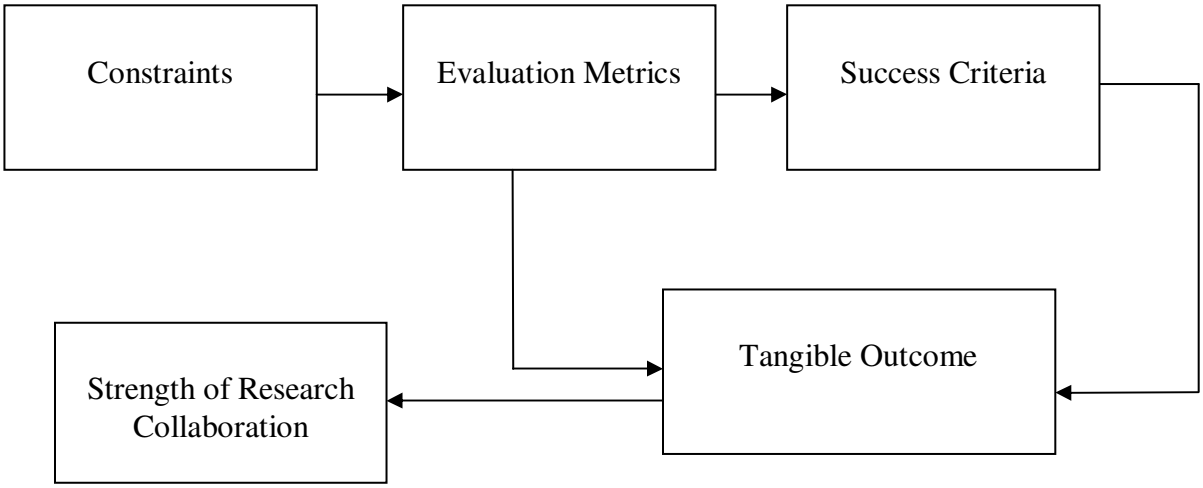

FIGURE 1: Overview of CASEM Model

In this research, during our initial survey we have sort out some crucial constraints that truly affect the collaboration of research centers and their collaborated R&D or university and industry e.g. Education and training, consultancy and technical service provision, conflict of intellectual property right, lack of technological competency, cultural difference and public policies are the key factors that can limit this linkage.

5. KEY EVALUATION METRICS

On the base of these constraints, we have generated key evaluation metrics like strong communication, joint venture, cooperative R&D agreement, knowledge sharing, cultural development financial support and communication. Each evaluation metrics have its own success criteria. These success criteria produce tangible outcomes that always include master's thesis and doctoral dissertations, patent or non-patented, licensed or non-licensed product or process are the evidence and the signal of successful collaboration between university and industry. Following are the key evaluation metrics with corresponding success criteria and tangible outcomes. Figure 2 shows the proposed CASEM Model with complete list of key evaluation metrics with corresponding success criteria to evaluate the strength of the linkage.

5.1 Education and Training

Lack of education and training is a line of limitation between university-industry collaboration. According to [13], [20] the failure of the transfer of computer technology to china was the small number of personal trained in the computer field and also the lack of understanding of computer software. Technology to be transferred and maintained in the firm appropriate education and training must be developed. Most of the time universities do not collaborate and licensed their technology to those firms who have not sufficient capabilities to maintain it. Because of this hindrance technology cannot be transferred and become useless and shelved in the library just for the references leading towards the wastage of resources. Consequently, universities have to export their technology to any other country.

We can develop education and training and cover this problem by using appropriate and corresponding evaluation metrics which is directly related to this constraint. Knowledge sharing and flow of human knowledge is among the most important evaluation metrics of university-industry collaboration and technology acquisition. There are certain success criteria that combined together to make knowledge sharing as an evaluation metric for education and training constraints. Amongst those success criteria, video conferencing, workshops, seminars, training, personal interactions, group visit to universities or industries for formal or informal meetings. During our survey we have analyzed that more the above events occur, stronger the linkage it is. For example, "Training" as success criteria: If we have more training on recent technologies, the more tangible outcome we generate. However wining of national or international funded projects is the immediate tangible outcome for training.

5.2 Culture Difference

Every year university-industry scientists take more pressure to work with each other and it is emphasized from the government to university-industry scientist to collaborate or cooperate to each other for the development of the technology in the country. The major constraint between university-industry collaboration is culture difference. University-industry fundamentally has their own culture, which reflects in divergent goals, time, orientations, basic assumptions, and characteristics. In our survey we have found some specific differences that are as follows. University always focus on basic research but industry quite oppositely always focus on applied research, the basic rationale of the university is to develop advance knowledge but industries have to increase their efficiency, the aim of the university is to generate new ideas but on the other side industries have to generate more profits, both characteristics is totally different, university is known as an idea centre but industry is known as product centre, university have open framework but industry want closed and confidential framework, university evaluation is possible by peers but industry always evaluated by the boss. So, we can say that from dawn to dusk they have different vision and opinion.

On the bases of these constraints and with the help of our survey some success criteria has been found to make this collaboration stronger and for the development of this culture. Before the agreement university-industry must have to identify their common goals, this is a prerequisite incentive for both partner and then from the beginning of the project until development they must keep the mutual perception. It can be helpful for achieving the goal and at the end they have to promote entrepreneurial concept for distributing the benefit equally. Development of technology is the tangible outcome of the same culture and the proof of the successful collaboration between university and industry. Thus mutual perception, similar objectives, common goals and entrepreneurial concept are indicating cultural development as an evaluation metrics of cultural difference.

5.3 Conflict of Intellectual Property

According to our survey and endless literature which shows the issue regarding the ownership of intellectual property, which always appears in the shape of quarrel between university-industry collaboration. Researchers need protection of property rights of their inventions even before proceeding with the partnership. But the acquisition of this right is very complex, difficult and multifaceted because industry also expects ownership of intellectual property (IP) by virtue of its huge investment. One of the findings of our survey, in vision of the university after the agreement industry becomes able to stop the flow of information and they put the publication of research result in delay. On the other hand industrialist commonly perceived that universities are too aggressive in exercising intellectual property rights this result is a hard line on negotiations, excess concern on the part of university administrators that they will not realize sufficient revenue, and unrealistic expectations[13], [14]. However conflict of intellectual property right not only damage the university- industry collaboration but also it is creating the monopoly and slowing the innovations of the country.

Given birth to by the Federal Technology Transfer Act in 1986 Cooperative Research and development Agreements (CRADAs) has ever since emerged as one of the popular and successful university-industry collaboration and technology transfer mechanisms from public research labs to industry and thus gained much interest of researchers [15]. In the developed countries, the improvement of science and technology and inventions of discoveries are some of the reason which justifies cooperative relationship and strong agreement between firms and research organization. Cooperative research and development agreement (CRADA) reflects close interactions through institutional agreement, group agreement, and strong commitment as success criteria which can be used to diminish every type of conflict with intellectual property right between university-industry collaboration. Before signing the Memo and starting the agreement terms and conditioned must be defined between both partners. Strong commitment can play a vital role to fulfill this term and condition. Commitment has a positive influence on the success of cooperative agreements between firms and research organizations. Every cooperative agreement requires a high level of commitment by the partners to make project and collaboration successful.

5.4 Time Constraint

One of the finding of our survey is time constraint which is major and big constraints between university-industry collaboration. The academic world always takes time to publish their research result without concerning towards market condition and expectation of the industry. On the corresponding side industries usually requires immediate solution of their problem and it's not ready to wait until the result of a particular research are available. Any specific time from the academic world to the firm is the meaning of the lost of the investment and income. By facing this problem industries always compelled to import the solution instead of cooperation or collaboration with the local universities seems to be best alternative. It is the responsibility of the university to provide the solution to the industry on time as they have signed the contract to work together in a joined research collaboration field.

For many firms, universities are too tricky to work with, and they avoid any form of university collaboration. Avoidance is not a solution, university-industry must create such calm environment

where they can work together patiently and smoothly, this process is called joint venture. Joint venture is a successful evaluation metric of university-industry collaboration that provide close working relationship concept. The basic collaboration process between academia and industry usually starts with each party identifying what can possibly acquired from the alliance and the potential needs of the other party. The strategy to develop the joint venture, both partners must have to organize the chart for identifying their basic needs and recognizing their mission.

5.5 Fund and Financial Difficulties

From different survey and interviews we have analyzed that Fund and financial difficulty is a major constraint between university-industry collaboration. University needs funds and equipment from the industry for continuing their research, and the life of their research is highly dependent on the financial support of the industry and government. No doubt industry provide fund to the University for the Development of new research but alternately expects commensurate return on the base of their investment [16]. This stringent perception of the industry always create problem between their collaboration. On the other hand (80 per cent) respondents from the university cited financial motivations for research and technological links with industries. Furthermore the fact that many respondents were also willing to discuss in detail about financial matter. According to them, 90 per cent part of the day, they expend in the research so, for the survival of their lives they need extra assistance.

Financial support is the contribution of both money and equipment made to universities by members of the corporate community [17], [18], [21] that is very significant and beneficial for both partners. Fund, grant, endowments, scholarship and internship are not only providing the assistance to the researcher but also the best success criteria of university-industry collaboration. Financial support is the one exclusive metric that can motivate the researchers to work with the industry in an open, positive and friendly environment.

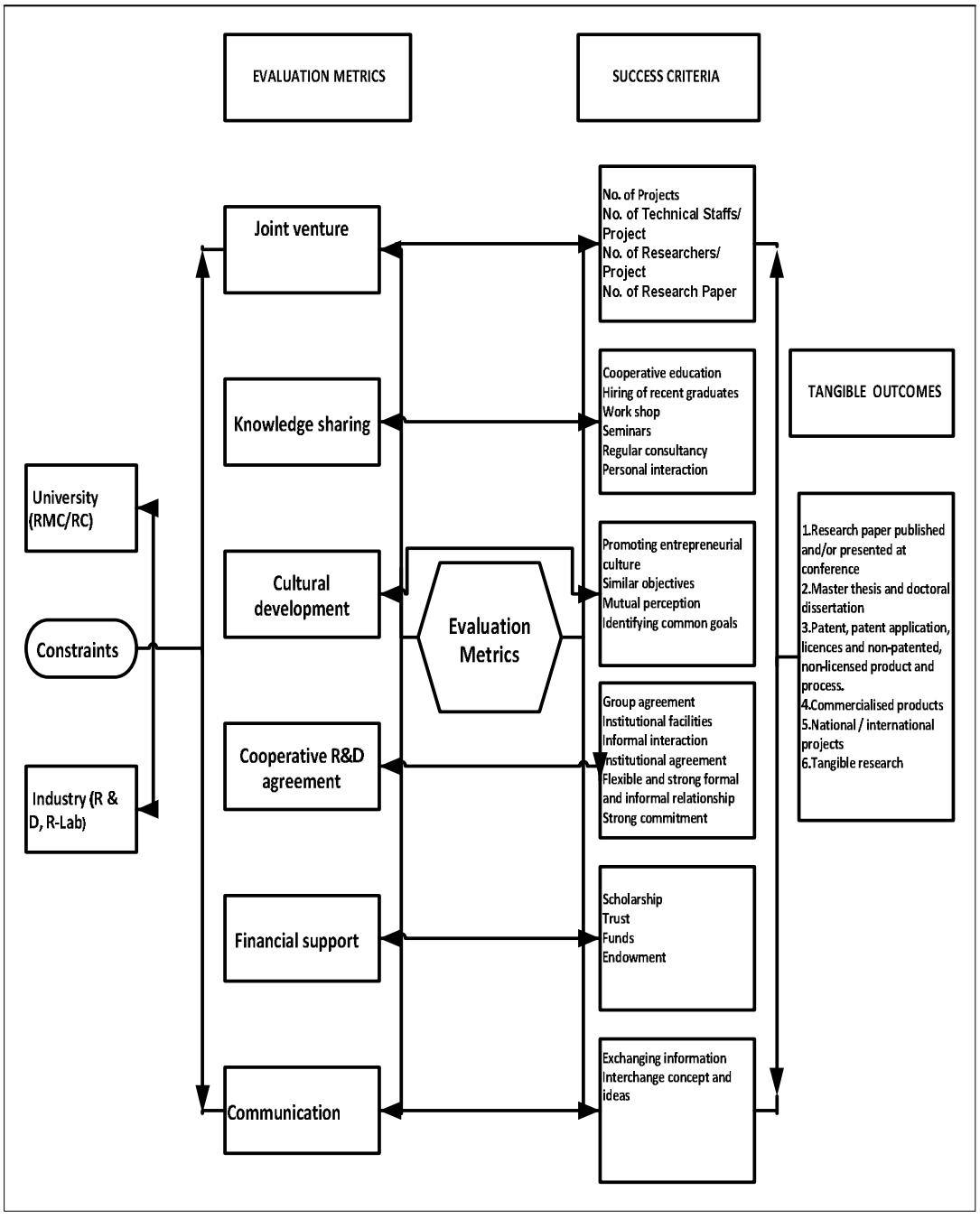

FIGURE 2: Proposed (CASEM) for the Evaluation of University- Industry Research Collaboration

5.6 Technological Competency

According to 60% respondents from different research centers of the universities, insufficient technological competency in the industries is also a barrier of university-industry collaboration. Technical assistance is usually required by a firm which has less experience in operation and setting up of any productive activity. It normally contains maintenance and repair of machinery, obtaining specification, assistance in setting up production facilities, advice on process know-how, consultation with manufacturing, personnel training and testing of final products. In short term, inadequate capabilities to tackle the situation and to maintain the technology in the firm need technical assistance. Since universities have time constraints problems due to their a lot of

academic stuffs, they don't want more complexities in their tough schedule that's why they do not collaborate with such industries where they have to provide technical assistance with the technology as well. Sometimes universities licensed their technologies to foreign countries where they feel free from every type of obligation for providing the technological assistance.

Licensing of the technology to foreign countries leaves a bad impact on the country image as well down the economy. University-industry can save the country image and the economy by the strong communication between them. Consultancy and technical service provision always depend on the frequent communication. Frequent communication allows both parties to share their problems and get the technical information. Regular exchange of information and interchange of concept and ideas is a success criteria of strong communication. The process of communication between two or more different organizations must be taken into high consideration within the context of inter-organizational relationships. Transmission of information, prompt decision taking, coordination of activities, and execution of power these all entities are possible in the existence of strong communication.

6. PERFORMANCE ANALYSIS

In our proposed Model, we used constraints, evaluation metrics, success criteria and tangible outcomes as parameters for evaluation of any sorts of collaboration between university and industry and especially for research collaboration. We have evaluated our proposed Model and response of key researchers from different research centers provide different statistics to the best candidates to be included in the evaluation metrics.

TABLE 1: The Constraints

ET	Education and Training
CD	Cultural Difference
COIP	Conflict of Intellectual Property
FD	Financial Difficulties
CT	Technological competency
TC	Time constraints

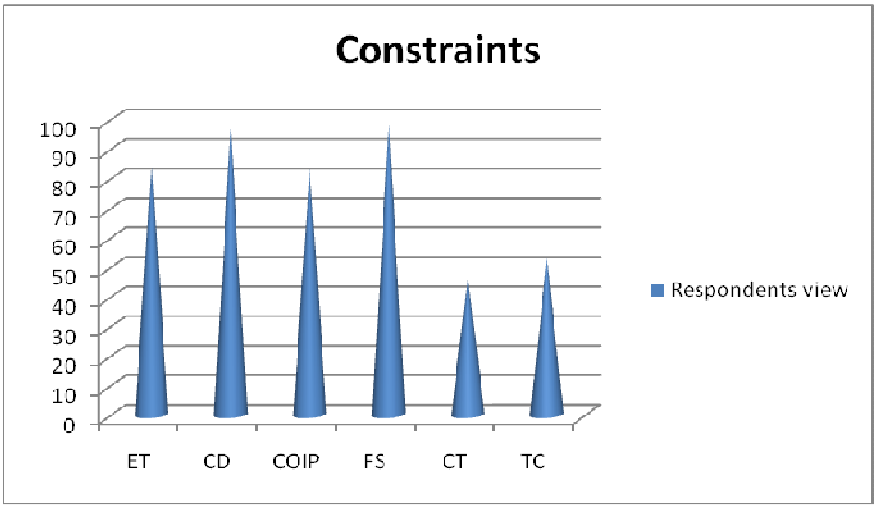

FIGURE 3: Constraints of University and Industry

In Figure 3, we have tried to analyze all those constraints that always are the major barriers between university-industry collaboration. Our first target was to explore the constraints of (U-I)

collaboration. The Figure 3 provides strong evidence that majority of respondents (researchers) agree that education and training (ET), Cultural difference (CD), Conflict of intellectual property (COIP), Financial difficulties (FD) are the best candidate to be measure at its priority to evaluate the strength of collaboration of university and industry. According to Figure 3, we can analyze financial difficulties, cultural difference, education and training and conflict of intellectual property right are the main constraints of university-industry collaboration. However, Technological competency (CT), and Time constraints (TC) are less chosen candidates by the respondents which were one of our hypothesis but cannot be ignored. Figure 3 shows that financial difficulty and cultural difference are going up to 93% and 92% respectively, while education and training and conflict of intellectual property right are going up to 82% and 80% respectively that is a clear picture of major constraints.

Figure 4 shows the graphs about the evaluation metrics and respondent behaviors on corresponding metrics. In this Figure, we can see how firmly respondent agree to joint venture (JV), Knowledge sharing (KS), Cultural development (CD), Cooperative R&D agreement (CRDA), Financial support (FS) and communication (C) respectively to be the best evaluation metrics. According to the graph, almost 93%, 91% and 89% respondents agree for FS, CD and KS respectively to be included in the category of best evaluation metrics while 81% and 79% of the respondents gave vote for JV and CRDA respectively and 70% respondents showed their interest towards C to be included in the evaluation metrics. However, many other evaluation metrics were also proposed initially in our hypothesis but majority of the respondents highly ignored their importance that is why those are not included in our measurement scale.

TABLE 2: Evaluation Metrics

JV	Joint venture
KS	Knowledge sharing
CD	Cultural development
CRDA	Cooperative R&D agreement
FS	Financial support
C	Communication

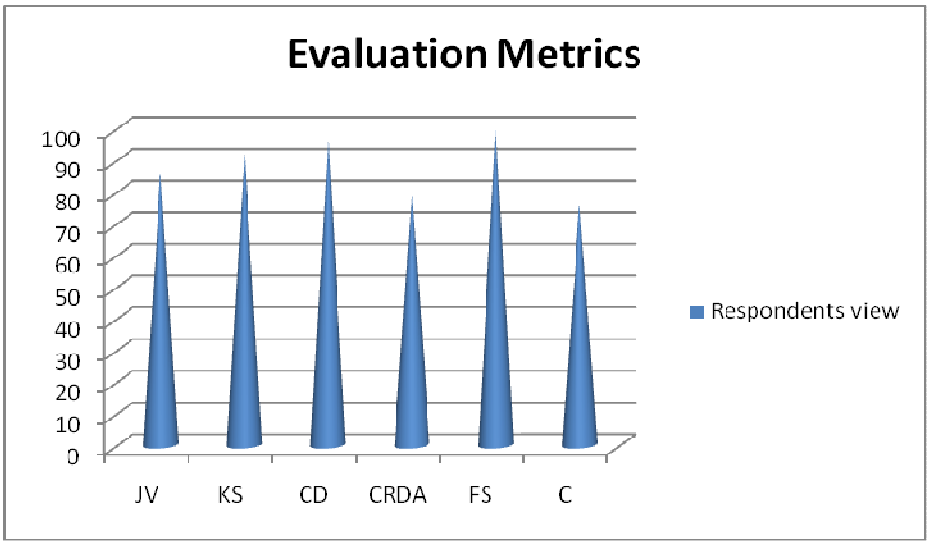

FIGURE 4: Evaluation Metrics for university-industry collaboration

Figure 5 provides the graphs about the important parameters to be included in the tangible outcomes from the collaborated research between university and industry. According to Figure 4,

majority of the respondents (researcher) agrees that Licensed or non licensed product, patent non patent application and commercialized product should be evaluate on their priority to analyze the strength of tangible outcomes. They are in the range of 91%, 90% and 87% of the scale respectively. while doctoral thesis (DT), ISI- Scopus research paper, and Masters dissertation (MD) are the second best candidate for the evaluation of strength of tangible outcomes of this collaboration because they are in the range of 81%, 80% and 71% of the scale. However, we have included conference research paper (CP) that also the candidate for tangible outcomes but small percentage shows the less priority of the respondents.

TABLE 3: Tangible Outcomes

DT	Doctoral Thesis
MD	Masters Dissertation
CP	Commercialized product
L or NLP	Licensed or non Licensed product
ISRP	ISI Research paper
CRP	Conference Research paper
PNPAPP	Patent and non Patent application

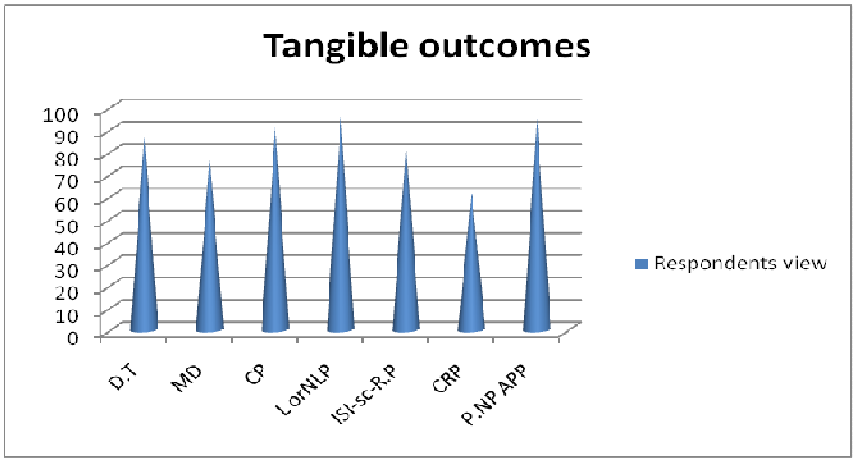

FIGURE 5: Outcomes of University-Industry Collaboration

Figure 6 is the most important part of the paper which provides broad ways to think or apply for the establishing and maintaining the research collaboration. Respondents took much interest during the survey and they agree with all the given points respectively to be the best success criteria of university-industry research collaboration. In the perception of the respondents these criteria are not only provide the equal benefit to both partner but also provide the commensurate return to them. In the perception of the respondents criteria 1, 3 6, 7, 8, 10, 13, 16 are the best candidate to be included in success criteria category while 2, 4, 5, 11, 12, 17, 18 are the second best candidate to be the part of success criteria category of university- industry collaboration. According to our structured interviewed process, we have analyzed that to finalize the parameters to evaluate the linkage, the success criteria should be prioritized exactly according to their percentage agreed upon by the key researchers as respondents

Number of Project	1
Number of technical staff per project	2
Number of research paper	3
Workshops	4
Seminar	5
Hiring of recent graduates	6
Similar objectives	7
Mutual perception	8
Common goals	9
Strong commitment	10
Flexible and informal interaction	11
Intuitional facilities	12
Scholarship	13
Fund	14
Trust	15
Exchanging information	16
Interchange concept	17
Interchange ideas	18

TABLE 4: Success Criteria

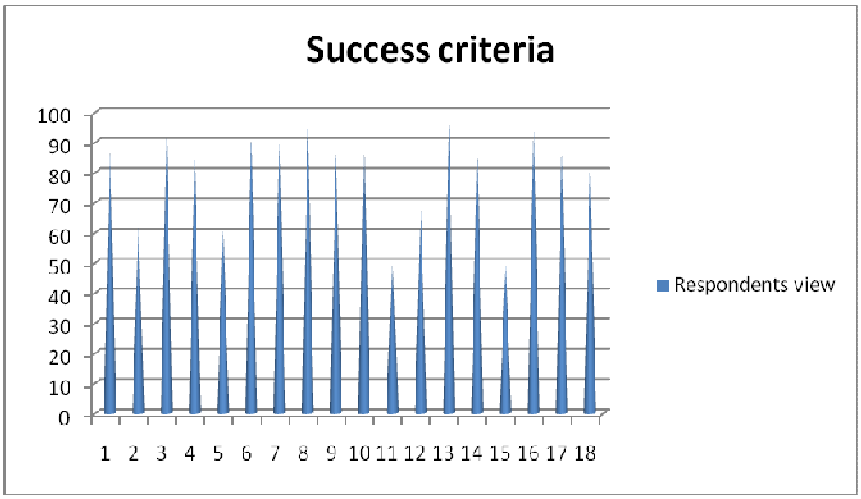

FIGURE 6: Success criteria for the Evaluation of University-Industry Collaboration

7. CONCLUSION

University-industry research collaboration is a sizeable subject not only for the scientist, business analyst but also for the policy makers. Despite of this interest a very few attempts has been taken for the evaluation of university-industry collaboration. In this paper, we have analyzed the major factors that is key responsible for the hindrance between the important research collaboration. On the base of these factors, evaluation metrics has been germinated that is not only helpful to evaluate the collaboration in different aspects of research collaboration but also give significant support to extract success criteria for each evaluation metrics. This success criteria helps to evaluate the linkage in closely to generate tangible outcomes, that are the basic need to complete evaluation process within collaborating partners. Later, in this paper, we have developed CASEM Model that is comprises of four specific parameters which are, constraints, evaluation metrics, success criteria and tangible outcomes. This model is exclusively responsible not only for evaluation of research collaboration but also all sorts of collaboration between university and industry can be evaluated.

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