Importance of Research at End User Level: Case Studies

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Abstract - Innovative ideas cannot be explored without research and experiments. However most research end up at laboratory level with some presentations and publications. Although we see a growth in computer based research at local universities only a small fraction of them had actually reached the end users due to some gaps that exists between research and commercialization. In this paper few examples of successfully research outcome that had reached the end users in Sri Lanka would be presented highlighting the importance of the beneficiaries than the research itself. Also how to bridge this gap to take the implementations of important innovative ideas to end-users would be looked at. Selected case studies in agriculture sector, dengue alerts, simulators, finger printing etc. would be presented.

I. INTRODUCTION

We have observed most research at universities are carried out to meet course or programme requirements than ensuring its usefulness to the society. Hence in this paper we will first explore what is research & development, and what is required to promote research. We will look at several end user level research that had been carried out at University of Colombo School of Computing (UCSC). Finally we will explore various drawbacks and possible areas to improve to promote research.

Research is a systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions. Research process usually commences with some ideas initiated by the student or supervisor. Researchers have to brainstorm and explore these ideas in order to decide which ideas would meet the expected outcomes. Once the ideas are finalised the student will have to research on that and develop the selected ideas to meet the expected objectives. Most ideas become innovative ideas only if they are developed involving large and diverse group of researchers. To make these ideas successful and usable for the end user we need to integrate technology with value for business and be able to market to targeted users.

II. RESEARCH OUTCOME

Innovation comes through new combinations made by an inventor or entrepreneur, resulting in a new product; a new process; opening of new market (such as Apparel Industry, Middle East Job; Software Industry; Tourism); new way of organizing the business and new sources of supply. Value of research should result in value creation for the government and society with more efficient and effective returns. How consumers access value of research is also important. We have many development project with special focus on Port & Aviation, Highways, Health, Agriculture & Fisheries, Tourism, Urban development and Power & Energy. While carrying out these projects it is important to be able to identify the value of these developments with respect to direct impact or value for the wider society. Most inventions have indirect impact where value may not be directly visible. This too has to be considered. Investing on the right products is also very important with many Hi Tech market value products being available for Electronics, Information technology, Telecommunication, Biotechnology and Nanotechnology.

III. SUCCESS OF IDEAS

All ideas will not be successful. Usually students and supervisors come up with 1000s of Ideas of which 100s of projects are tried out at undergraduate, masters, postgraduate research level. However, only few (10) of these projects will have some success resulting with some publications. Among them some (05) projects may win awards by competing at competitions. However, the key question is how many of the will get materialized as a product to reach the targeted end users. There are many constraints in form of budgets and procedures to follow when trying to achieve these goals. Also researchers are not good at marketing and commercialization. Hence achieving event one innovative solution from among 1000s of ideas is a big challenge.

We have observed that in Sri Lanka we have many (76) research focussed institutions including universities in the fields of Agriculture (21), Veterinary (02), Marine and Aquatic Resource (02), Industrial and Engineering (09), Health Science (10), Fundamental Studies (01), Applied Sciences (14), Social Science (13) and Science

&Technology Policy (04). Universities should take a lead role focusing on quality research than quantity. Time spent on research has to be counted as part of the researches workload to encourage spending time on research and contributing with new solutions. As most research are done by students we should also focus on developing problem solving skills among students with all students carrying out some research project as part of their degree programme.

Concept of knowledge hub has been highlighted by the government. However only few targeted research projects have been funded to promote research. Most research do happens with some student centred learning activities. Government also have recognized value of research to some extent. However we do not see adequate incentives to do research as well as the private section participation despite providing tax incentives to carry out research. Coordinating Secretariat for Science Technology and Innovation (COSTI) is working towards solving this national issue.

IV. SUCCESSFUL CASE STUDIES

Next we will look at several successfully case studies all taken from research carried out at the University of Colombo School of Computing (UCSC). Vidusayura Ship Simulation System is a development of a virtual learning and training environment for maritime education which allows simulating ship models under complicated environment conditions such as wind, wave and sea currents. It can compose six degrees of freedom ship motions with respect to rudder, throttle and environment conditions. Vidusayura is development of a virtual learning and training environment for maritime education which allows simulating ship models under complicated environment conditions such as wind, wave and sea currents. Conventional maritime classroom lectures can only explain ship's individual phenomena one by one but they are occurring simultaneously so that it is not easy to teach and learn properly. However by using this virtual environment ships, various phenomena which are occurring simultaneously can be explained easily. Trainees can use this virtual environment and define various environment conditions and study ship motions at their own pace. This research outcome has been installed at several locations of the Sri Lanka Navy Vessel Training Units and at the Ocean University of Sri Lanka. Another similar solution is the K-8 Fighter Jet Simulator which is a flight simulator developed for the Sri Lanka Air force Training Unit.

The Field Artillery Simulation System (FASS) is used to train forward observers who play a major role in directing artillery fire to identified enemy targets and in providing feedback to zero in on targets. Currently the Sri Lanka Army trains forward observers using live fire. This proves to be extremely costly. FASS simulator allows this training to be done at a fraction of the cost by recreating the artillery-firing scenario in a projected immersive environment using computer simulation and 3D models. FASS is a complete training system that helps the instructors to control the training and monitor the progress of the students. It has three main components - Trainer station, Trainee environment, and the Gunner station. The trainer can load 3D models of different environments with different lighting and environmental conditions. FASS allows 3D models of the firing ranges to be developed independently. This research outcome is used by the Sri Lanka Army Training Unit.

Siyara is a real-time 3D Vessel Traffic Management System (3DVTMS) for commercial/ large-scale ports and was installed at the Colombo harbour in August 2013. Siyara consists of the full scale 3-Dimensional (3D) view of the harbour environment and the conventional 2-Dimensional (2D) traffic monitoring view. The observation capabilities of the solution are not limited to single static location. The operator has the freedom to select viewpoints and perspectives within the 360 panorama scene and view moving or static objects. It supports for multiple viewers such as mobile devices and PCs to monitor the real-time traffic. It supports in planning port operations, address safety issues such as environmental impact of shipping accidents and address security issues. It keeps track of vessel movements, voyage information and other important facts. It supports to wide variety alarms and hazard warnings. 3D view enhances the user's situation awareness. It leads to a significant reduction in human error and increases the user efficiency. This research outcome is used by the Sri Lanka Ports Authority.

A mobile application targeted at tourist visiting Galle, a southern city in Sri Lanka. Galle has been used as a trading port around the 14th century and later occupied by the Portuguese, Dutch and British who developed Galle as a fort city. Walking around the city, you witnessed various relics from the colonial age, with a lot of historical sites. This app allows to guide the users explaining these historical sites. Mo-Buzz Dengue app is also another mobile app to enable the general public to contribute towards the fight against dengue in Colombo. Dengue has severely affected Sri Lanka in the past two decades. In 2014 the country reported nearly 40,000 dengue cases, a level of burden that has been consistent over the past few years. Mo-Buzz Dengue will help to crowd-source dengue surveillance and provide education about dengue at the same time. Effectively,

the general public can now use the Android-based Mo-Buzz Dengue application to send a complaint about mosquito breeding sites with the click of a button. This can be done by taking and sending a picture of the breeding site using the application, which is automatically geo-tagged, thereby informing the CMC about the exact location of concern. Based on the geo-coordinates of the citizen inputs, the complaint will be routed to the public health inspector (PHI) responsible for the respective ward. The PHI will investigate the complaint and take necessary actions after which the citizen complainant's record will be updated. Along with this function users can also learn more about dengue prevention through an educational module, learn about dengue danger zones within the CMC jurisdiction on a map, and directly call the nearest Medical Officer of Health (MOH) if needed.

A social life network to enable farmers to meet the varying food demands of the population is a mobile based information system to support farming activities in Sri Lanka. It provides information required to support activities such as crop selection and cultivation planning in the context of farmer, farm location, season and task being performed. The system also provides a facility for farmers to obtain market prices and sell farming related products and services to other farmers. Information on crops are extracted from an ontology to reorganise published crop information that would be queried in context and processes to empower farmers. This system can enhance the flow of information in the agriculture domain by aggregating or disaggregating information produced by some stakeholders to be consumed by others. This research solution has been deployed in Dambulla and Ponnanaruwa among selected farmers.

The Automated Fingerprint Identification System (AFIS) designed to help law enforcement authorities to identify and apprehend criminals was launched in 2014. The AFIS system provides an efficient software solution for fingerprint identification and storage for the Sri Lanka Police. Use of the system does not require significant technical knowledge to operate and also provides an easy "cut and paste" option to transfer manual rolled fingerprint records into the database with ease. The system represents a quantum leap in fingerprint identification when compared to the manual identification system that was previously used by the Police Department. The AFIS based fingerprint searches are faster, allow searches across larger pools of potential perpetrators and the system assists in marking key identification features of matched prints. The System has the potential to revolutionize crime investigation in Sri Lanka providing a clearer evidence base to solve crimes and apprehend criminals. Additionally, the innovation of tracking emerging trends and patterns of criminal activity and enabling GIS based spatial location of crimes will provide the police with data on "hot spots" and can encourage proactive policing to prevent crimes. This research outcome is used by Sri Lanka Police and already help them to solve many crime cases.

Not too long ago the very idea of getting a birth certificate over the counter would have been anything but a dream. However, today it is actually happening – be it Birth, Marriage or Death certificates – copies can actually be obtained over the counter. The BMD project covers 13 of the 24 districts and is made possible through the Lanka Government Network which connects 375 public institutions and is a testament to what is possible through seamless governance. This research outcome is a document management system to manage Birth, Marriage Death Certificates of Sri Lanka citizens.

Pokuru PC, a low cost multi-terminal computer laboratory was initially developed for the primary school kids at the Dharmashoka College, Ambalangoda in Sri Lanka. During the project period, Ubuntu operating system was customized to support multiple dummy terminals. School teachers and school kids were trained to use the terminals. As most of the school going children would not be using complex applications that need huge amount of processing power this solution of ten multi terminals could serve up to 40-60 students depending upon the number of dummy terminals they contain. This research outcome is now deployed by few small investors.

V. BETTER IMPACT

Modern mobile phones have many sensors allowing communications, identification of locations, camera, video, radio, music, SMS, E-mail, Internet, etc. These characteristics has be incorporated into modern mobile applications to increase impact of the application.

Characteristics of research include the willingness to take risk. However student are not in a position to take risk. Therefore universities and the government should take the risks on behalf of the students. University should provide incubators to develop successful student research and also assist in obtaining intellectual property rights (IPR). Researches also should accept high levels of ambiguity and uncertainty with original thinking. A passion to drive the idea through to conclusions and the ability to inspire passion in others should also be part of the research cultures.

Investments and collaborations are also very important to strengthen research and development (R&D) inputs; industry links with Universities should be established; cross-border collaborations with importance of participation in global value chains should be promoted; scientific performance in terms of research quality, research papers and citations and highly cited papers per cost on R&D should be looked at.

VI. WEAKNESSES

We identify many weakness in the current system. Many research does not look at marketing and commercialization of research. Also less emphasis is given for publications in peer reviewed indexed journals as focus had been a publication than in a recognized journal. There are new knowledge generated in forms of books, monographs, research reports and Postgraduate thesis. However, time spent on R&D is not counted as part of the workload calculation and good students look for overseas universities to do research. There are difficulty in attracting good students due to low salaries and limited facilities. Also it is difficult to complete good research by doing research on part time basis.

Many common issues can be identified as reasons for lack of innovations. R&D does not get commercialized with copyrights and patents, where as in other countries successful ideas gets better value; Cost of publication and dissemination of research is very high with limited support for researchers; Less incentives to encourage multiple good quality publications within a year due to funding issues and barriers in releasing funds; Lack of political will to invest on R&D is also seen with priorities being short term; Procedural delays in obtaining approvals and having to follow national procurement guidelines; Lack of knowledge of proper procurement procedures; Inefficient and complicated procurement procedures; Attitudinal problems in the administrative system; Difficulties with overseas purchases and payment; Inability to use the credit card system for online purchasing; Undue delays at custom clearing; Few staff promotions at higher level or quality not maintained; Unaware of the research activities happening locally; Most research does not continue to benefit the community; Research groups are not strong to compete internationally; Few trying to supervise many affects quality of research.

At UCSC as annual achievements we see many publications (70), awards received (10) for the developed product prototypes. However due to the lack of support for Public-Private partnership, Patenting, Licensing, Selling patent, Start-up companies and Scale-up using internal business facility not many of these solutions reach the end users.

VII. CONCLUSION

It is important to promote research culture in a university environment providing adequate support and facilities. Support for focused research is the key as it would help to take the ideas from research to deployment. Promoting collaborative research helps to think outside the box by looking at many options. Reporting the research finding too should be more targeted to get the best impact of the research published. Universities need to have a support mechanism to commercialize research findings and to obtain IPR and patens as needed. Exploiting successful research outcomes to ensure its adoptability by the end users should be the ultimate goal of targeted research.
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