Innovation in Uganda:
Current Opportunities and Obstacles

Resilient Africa Network

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Overview:

[This Overview was prepared by the RAN Secretariat]

Quinn and Cameron from Makerere University and supported by ResilientAfrica Network (RAN) conducted a rapid assessment of the current environment for technological innovation in Uganda (Quinn and Cameron, 2013). The assessment sought to focus on the current innovations in Uganda, how innovation is supported as well as the barriers that hinder innovators from carrying out their innovations. The study looked at innovations in multidisciplinary sectors such as food science, agricultural, computing, and also looked at a variety of innovators including graduates, undergraduates, professionals, and those without formal qualifications. This was a qualitative study conducted within a period of 1 month among 25 Key Informants. These comprised of student innovators and faculty in the academic sector as well as those innovators and those supporting innovation (mentors) in the corporate and non-profit sectors.

Results from the report indicate that there is evidence to show that Ugandan innovators are generating an abundance of ideas, but of those ideas, few "reach a stage of full implementation, or demonstrate scalability and self-sustainability".

One of the key findings the researchers observed was that financial constraints shape the activity of graduates and students innovators in Uganda. Innovators are primarily motivated to find jobs rather than work on their projects due to the uncertainty and financial constraints as well as financial pressure from family members. This was evident as all innovators interviewed revealed that they worked on their projects alongside several other "ongoing enterprises, part time jobs and consultancies".

Another key finding was that these innovators were often uncertain about the process of bringing about a new technology successfully and they find that the process a risky one with

many unknowns. Additionally, young innovators often lacked the "inside knowledge of the ways in which companies or government departments operate". They also have difficulty trusting others with their ideas and such hesitancy often "leads to small teams and reluctance to engage with other parties who might be able to provide assistance". The researchers noted that the Ugandan legal "processes to enforce intellectual property rights are weak". The artisans also identified the trust issue to be a problem when innovating. The mentors had "varying experience levels at developing new ideas and getting them deployed" and often their backgrounds are not "necessarily what is required for innovating and deploying new technology". They were challenged in having adequate time for carrying out mentorship of innovators and in general, the compensation for mentors performing these tasks is not adequate.

The study mainly focused on innovations in technological sectors and found evidence/opportunities for potential success of innovations in the following areas: making better use of natural resources, technology for improving access to information, import replacement with products that are better adapted to local constraints among others.

However, interviews with informants revealed bottlenecks to successful innovations in Uganda namely: reluctant entrepreneurs where innovators "would prefer not to be innovating" but instead working at a job that provided financial security. Furthermore, innovators did not appreciate that innovations take time and trust needs to build especially when working in teams. Others included entrepreneurial skills gap to identify opportunities and risks, create business plans, or manage projects financially. Pilotitis referring to "clear difficulty in scaling up from prototype to full deployment" and academic mentorship has the particular problem of formally ending upon completion of a particular degree. Another issue is the problem of mismatched mentors which leads to mentors who are often spread too thinly especially where courses are oversubscribed at university such that the amount of time that a faculty member devotes to any one student project might be less than 30 minutes a week.

Finally, the researchers make recommendations related to the innovation processes in Uganda and support mechanisms (e.g., finding the right partners, hiring the right staff, and identifying opportunities with the right balance of risk and reward). They provide a summary of the benefits and drawbacks that have been experienced with different methods of support for innovation in the past. They recommend that the Resilient Africa Network, focus on "how best to catalyze existing efforts in order to see high-impact innovation in the future".

The barriers accentuated to in this report relating to the Ugandan context are similar to those experienced by other innovators in other developing countries. The RAN project believes that a number of support methods and practices, identified in the report can be applied to increase the portion of technical and social innovations that succeed in benefiting large numbers of

communities. The common theme of these suggestions is to proceed with a mindset of continuous improvement. In that spirit, we look forward to receiving feedback on this report and to continuing the endeavor to improve the outcomes for innovation in Uganda.

The Full Report

Abstract

This study is a rapid assessment of the current environment for technological innovation in Uganda. To shed light on what innovations have been possible in recent years, as well as what the factors are from holding back the realization of potential, we sample from the experiences of innovators at different levels and backgrounds: from students and faculty in the academic sector, as well as from innovators and mentors in the corporate and non-profit sectors. Using experiences from previous efforts to catalyze innovation, particularly through Makerere University, we also aim to provide a summary of the benefits and drawbacks that have been experienced with different methods of support for innovation in the past. We conclude with recommendations on innovation processes and support mechanisms that could raise the yield on time and money spent by innovators.

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1 Introduction

Conditions for innovators in Uganda have improved in recent years. Technological and social change are continually opening up possibilities for new ideas to be deployed, and efforts to develop new technical solutions to local problems—while still modest from an international perspective—have become more ambitious and more indigenous. Furthermore, these efforts are taking place not just within universities, but also the commercial, non-profit and informal sectors. This has led to an abundance of ideas about ways in which new technology might contribute to sustainability and resilience in the country.

Some of these ideas are low-tech and widely deployable, such as improved cooking stove designs, baking machinery made from recycled materials, or methods of making fuel from household refuse. At the other end of the spectrum, more sophisticated commercial services such as 3D printing and GPS tracking are also emerging in Kampala. Several other concepts are being trialled across the disciplines of engineering, agriculture, food science and computing; a few of the examples might be new designs for efficient food processing machinery, development of agricultural techniques to counter disease, equipment exploiting renewable energy sources, portable equipment to measure soil composition, the use of phones for trading and communicating market conditions, or with the use of satellite data to track forest encroachment or predict crop failures.

Despite this fertility of ideas, however, few innovations reach a stage of full implementation, or demonstrate scalability and self-sustainability. This raises questions for initiatives such as the Resilient Africa Network, on how best to catalyze existing efforts in order to see high-impact innovation in the future.

1.1 Study aims and methods

The aim of this study is to provide a rapid assessment of the innovation environment in Uganda and to suggest how best to work within it. By interviewing a selection of key innovators and others involved in support for innovations, we attempt to explain in qualitative terms what the main opportunities and obstacles are in this domain. We attempt to look at innovations across a number of sectors, including food science, agricultural, computing, and innovators from different backgrounds, including graduates, professionals, and those without formal qualifications. We limit

the scope of the study to technological innovation in these sectors, but note that there may be several opportunities for non-technological innovation such as in policy formation. Furthermore, we aim to assess how different previous schemes to support innovation have fared in Uganda. To do this we solicited in our interviews the reactions of innovators who were supported under them, and those managing them. We then attempt to draw conclusions about different approaches to innovation support based on past experiences, and the implications of this for the Resilient Africa Network in terms of effective modes of support for innovation in Uganda.

1.2 Scope of the study

The study is mainly based on the feedback of key informants, each of whom was either an innovator themselves, or otherwise involved in supporting the innovation environment in Uganda. Informants in the latter group were either faculty, managers of incubators, or in other categories such as NGOs.

Interviews were conducted with 25 key informants. Clearly it is not possible to get a comprehensive picture of innovation in the entire country with this size of survey, however the informants were chosen such that they could give us a general impression of current circumstances. The emphasis is somewhat on innovations that use ICTs, as this is currently an area in which much energy is being devoted, although we also tried to be representative of other significant fields such as mechanical engineering, food science and agriculture. The spreadsheet accompanying this document gives an overview of these interviews.

While the interview format is useful in assessing the main issues, it also has drawbacks. Interviewees understandably try to emphasize their successes and are reluctant to go into detail about their failures. They are also inclined to make a case for funding: for example, incubator managers support funding for incubators, and students support stipends for students. We tried to interpret the feedback in light of these factors. We also documented our own reactions to the interview questions, in order to separate our personal experiences from the feedback of our key informants.

1.3 Structure of the report

The remainder of the report is structured as follows. First we try to outline the perspective of innovators in Uganda from different backgrounds. We break this down into young innovators (students and graduates), professionals, and artisans from small-scale industry. Next, we carry out a similar description concerning the perspective of those mentoring innovations. Following that, we try to distill from interview feedback what the main opportunities seem to be for increasing the effectiveness of innovation in Uganda. This includes the types of projects in which there is a track record of success, the domains in which there has been most impact, and the management process features that have improved the return on investment. Conversely, we then discuss the main challenges for innovators, as described by the key informants. We conclude in two sections. First we discuss the most effective methods and forms of innovation

support in Uganda, using examples from previous projects and funding schemes. In the final section, we draw overall conclusions.

2 Innovator perspective

2.1 Students and graduates

Many of the innovators we interviewed were either recent graduates or students. As well as being a particularly prominent demographic in the innovations environment in Uganda (accounting for the majority of attendees at innovation-focused meetings such as Mobile Monday Kampala, for example), this is also a group focused on by the Resilient Africa Network.

Our first observation about graduates and students attempting to innovate in Kampala is that often the primary motivation is to find a job rather than to work on their own project. This is because of the uncertainty and financial constraints of life in Uganda, and the relative scarcity of good salaried positions. Even when an innovation seems to be gaining traction, the appeal of a job remains: Respondent 20 of the WinSenga team (worldwide finalists in the Microsoft Imagine Cup) explained that team members still left the project for jobs even after winning USD 50,000 in funding.

It is not only personal preferences that play a part in this. Graduates are under financial pressure from family members to find a job, preferably in one of the professions, having been sponsored through education as a form of investment by parents or other relations. Respondent 9, former manager of the National Software Incubation Centre, explained the difficulties that students have in explaining the concept of incubation to their parents: in general, families are not very supportive and prefer their graduating relatives to find "proper jobs" in order to help with their share of extended family financial support.

Financial constraints therefore shape the activity of innovators in Uganda. Respondent 17, who developed a sonar valley-dam monitoring system during his MSc studies, was entirely self funded and had to spend around 500 USD on equipment, leaving little budget for pursuing the project further after completing the degree. We did not speak to any innovators who worked exclusively on their projects; each innovation was always one of several ongoing enterprises, part time jobs and consultancies.

Young innovators we interviewed displayed uncertainty about the steps required to deploy a new technology successfully. The concept of creating a new technology based business is relatively novel in Uganda, which has different consequences. One is a perception of a new field of opportunity, in which the difficulties of previous generations might be sidestepped by technological advancement. The process of innovating is perceived as meritocratic, a refreshing change from other walks of life. However, another result of the novelty of innovation is a feeling of mystery about processes such as how to market innovations, negotiate partnerships and so on. Recent graduates furthermore have little experience of business, so even things which are routine to older professionals, such as arranging meetings with potential investors or clients, are unknown territory. As a result, the process seems risky and full of unknowns.

Without inside knowledge of the ways in which companies or government departments operate, it is difficult for many innovators to know how to advance their ideas. Public sector departments can appear to be closed to approaches from innovators with new ideas. Businesses are felt to be easier to approach, though still requiring a personal contact in order to make progress with. Sometimes after experience of rejection, the reasons seem opaque. Respondent 19, discussing his crop disease monitoring work, was promised collaboration on field trials of his system for over a year by a government body. Despite great initial enthusiasm from managers, several postponements were made and to date nothing has happened with no explanation.

Young informants we spoke to perceived a problem with trusting others with their idea. This leads to small teams, and a reluctance to engage with other parties who might be able to provide assistance. Since in Uganda the legal processes to enforce intellectual property rights are weak, these trust issues can be realistic. For example, Respondent 14, a computing student in the Software and Business Incubation Programme who had developed a QR code scanner application which was going to be used for checking taxi licenses. This team had several meetings with Kampala City Council Authority (KCCA), and had a go-ahead from the executive director. However, an employee within the IT department of KCCA had a company which was able to develop a rival system—using the plans which Respondent 14 and team had developed—and used their internal lobbying power to win the contract instead. Therefore some prefer to keep teams small and not to disseminate their ideas widely, even if it effectively means shelving the initiative.

All the graduate and student innovators we spoke to have usually come up with their own ideas, even though they might not have much experience in their proposed field.

2.2 Professionals

The picture looks different for innovators in later stages of their careers, e.g. involved in donor-funded projects to apply new technological ideas or moving from salaried positions to running their own enterprises. The success rate of innovations initiated by experienced professionals seems to be higher. Respondent 4, health systems strengthening coordinator at UNICEF, points out that the average age of successful innovators in the USA is 37 years, and that younger innovators have unrealistic expectations of hitting the jackpot. Professionals who have been based in Uganda particularly have an advantage in perceiving problems to which they can identify a solution, or other forms of opportunity. Respondent 3 of Digital Solutions began his development career in Uganda observing problems with managing internet cafés. He was able to assemble a team which went on to diversify into telecommunications software which is widely used internationally. Respondent 22 of SchoolMaster identified similar problems with the management of schools, and began developing a system in consultation with local headmasters. He used the salary from his day job to support a staff of five others doing development and marketing. Respondent 18 saw an opportunity in picking up a cooking stove design project which had been run in Makerere, in which considerable resources had already been used for

marketing and product development.

Postgraduate students in Uganda might often fit better in this category, since the average age of MSc and PhD students is higher in Uganda than in, say, the US. Respondent 23 began work on the mobile auction system Kudu after many years of experience managing IT services and software development; this experience helped in both management skills and having a realistic expectation of what might be involved in running trials of a new system.

NGOs and donor-funded professionals working on new technology face a different type of environment in which politics is a key factor. Respondent 5, who has worked on large projects such as ICT4Manpower (focusing on medical records systems) cites the difficulties of working with ministries where each partner is playing the "development game" to maximize rewards.

2.3 Artisans

A different category of innovator is found within the small-scale industry sector. For example, Respondent 11 is a self-trained metalworker who dropped out of school and learned to construct machinery from readily available materials. He has three colleagues of similar background at his place of business in an industrial area of Kampala. One of their products is a wheat mixer fabricated from steel plates and a system of moving parts including a car differential. This use of recycled materials means they can produce items at much lower cost than imported alternatives. They can also make machinery suitable for the rigors of Ugandan operating conditions, another reason their customers prefer them to imports (the latter being dependent on availability of spare parts).

Respondent 10 is a manufacturer of welding, charging and other electrical systems. He spent five years as an electrician working on domestic and industrial installations and repairs, before setting up his own workshop. Similar to the metalworkers, he reports that his customers prefer his products to imports because of both lower cost and because he can construct equipment which is more resilient to power surges, blackouts or variable voltages.

The trust issue identified for young innovators is also present amongst engineers in the informal sector. Respondent 10 told us he retains certain key information from his assistants in order to have job security.

3 Mentor perspective

We next describe in general the perspective of mentors who are involved in supporting the innovation ecosystem in Uganda. We interviewed two types of mentors: faculty from Makerere University and managers of business incubators in Kampala.

The mentors themselves have varying experience levels at developing new ideas and getting them deployed. Faculty in Makerere University, for example, are naturally from an academic background which rewards scientific progress or teaching ability, but less so innovation in a form which has practical impact or engages with the community. Other mentors are from businesses—the experiences gained in their careers is not necessarily what is required for innovating and deploying new technology.

Incubators in Kampala operate under different models. Either some amount of money is charged for use of facilities (e.g. Hive CoLab), or a share in the company is taken (e.g. Outbox). Some incubators have a particular focus on providing management advice, and assistance in defining goals and strategy (e.g. the Software Business Incubation Programme and Mara Launchpad). Others are more hands-off and aim to encourage networking through seminars and the like (e.g. Hive CoLab).

In the cases where mentors rely on income from subscribers, the screening tends not to be very rigorous. This is not just a problem for incubators, but for universities. Makerere is oversubscribed due to the necessity of enrolling many private students to collect enough tuition fees to cover running costs. The load of academic supervisors is therefore high, and in our experience supervisor contact time for a student project in Makerere might work out at only a few minutes per week. Where there is an incentive to be more selective, such as for incubators who wish to profit through their shares in the startups, this screening process works better, such as for Mara Launchpad in which a "Launch Fund" finances the approved teams. Respondent 3 of Digital Solutions has a variety of screening methods including an aptitude test in the form of writing an essay on a topical issue.

Mentors report that the ideas they are asked to supervise are sometimes unrealistic, or wishful thinking. For example, there is a lot of focus on apps or SMS services; Respondent 2 points out that these might be completely unusable by rural users with low literacy, and that younger innovators need guidance on critically evaluating the feasibility of these ideas.

Mentors from academic institutions tended to be most active in suggesting ideas for people to work on. Incubators expect teams to apply with a concrete idea and business plan which they can evaluate.

Compensation for mentors working with incubation programmes is patchy: both Respondent 1 and Respondent 3 raised the issue of incubators not having enough funds to pay their mentors

adequately.

4 Opportunities

In this section we analyze the categories of innovations in which there are the clearest signs of opportunity. As described in the study aims, we focus here on technological sectors, although there are likely to be significant non-technological innovation opportunities in Uganda as well. From the feedback given by informants in this study, we can break down the technological ideas which appear to have highest potential impact in Uganda as follows:

- Technology for making better use of natural resources: e.g. food science mobile fruit processing unit, Mwoto Stoves, mushroom growers.
- Technology for improving access to information: e.g. QR Technologies, medical record systems, Kudu.
- Import replacement with products that are better adapted to local constraints: e.g. electrical power equipment, car parts, grain millers.
- Technology for information collection: e.g. ICT4Manpower, District Health Information System (DHIS2), valley dam monitoring, crop disease survey.
- Technology for compensating for lack of human experts, or limited training of available personnel: e.g. WinSenga, or educational innovations.

There is an abundance of ideas for new technologies in all these categories. Although many of these ideas are not practical, it seems that good vetting can lead to promising results. The Food Science and Technology Business Incubation Centre takes vetting quite seriously, and correspondingly has had good results in fielding their products—for example having them stocked in supermarkets or trialled with communities.

In terms of human capital, we have seen that there is ample capacity for converting ideas into prototypes. The technical skills of innovators seem to be adequate, even if other entrepreneurship skills are lacking (discussed in the next section). For example the Digital Solutions team have contributed significantly to the development of Kannel, now a worldwide industry-standard software package in telecommunications.

We find that users in many sectors are enthusiastic and ready to experiment with new technologies, even if they are held back from adoption by costs, bureaucracy or gatekeepers (Respondent 18, Respondent 22, Respondent 14, Respondent 17).

Human capital is increasing, and there is not a great problem with brain drain. Furthermore, we find that innovators are prepared to work hard. Despite a finding that innovators' time tends to be fragmented across many simultaneous projects, this is because of the need to diversify sources of income in response to uncertain economic conditions. Given sufficient financial

stability, we find that innovators are more likely to focus sufficiently (Respondent 23, Respondent 3).

We next outline sectors in which we find particular evidence of potential for innovation in Uganda.

4.1 Agricultural and food processing

Some of the innovations in our study which appeared to be most practical and with highest community impact were related to agriculture and food production. Since Uganda is primarily an agricultural economy, there are several opportunities for new technology to have a positive effect on resilience. For example, Respondent 13 from the Food Science and Business Incubation Centre reported innovations such as the mobile fruit processing unit, which has so far been used to process 100,000 tonnes of mangoes. This meets a need in the community—field trials showed that fruit could be processed by the mobile unit which otherwise would have spoiled—improving livelihoods and with a clear economic case for sustainability. Another example of high-impact innovation is within the School of Agricultural Sciences, developing improved crop varieties for increased yield and disease resistance.

4.2 Small-scale industry

Other encouraging interviews conducted for this study were concerning small scale, informal efforts. For example, our interview with Respondent 11 concerning his metalwork and lathe operation showed ingenuity being applied to meet local needs, such as using recycled car parts to make new machinery, and in fabricating baking equipment from other recycled materials. Therefore this sector seems particularly promising, in that such innovators provide value, increase resilience, and do it profitably enough to make a livelihood, with no external support. Ideas which have evolved within the local market by artisans can therefore have certain advantages over more internationally recognisable forms of innovation (such as VC-funded technological start-ups). When assessing innovation in Uganda, it might be easy to overlook the opportunities in the informal sector.

4.3 Computing

Computing (especially mobile computing) is currently an active field in Uganda, being represented more than any other technological discipline amongst our informants. While apps to run on smartphones have their limitations, and are at risk of being over-hyped, there are clear opportunities in the information-gathering category.

The best ideas in the computing sector make a strong economic case. While some projects we have seen in this sector are based on an over-optimistic expectation of the impact of producing a phone app or some other software, there are others with a more convincing analysis. SchoolMaster, for example, has demonstrated that the system can pay for itself by reducing other administration costs. Kudu creates profit for users and reduces opportunity cost.

WinSenga showed a business case in replacing more expensive medical equipment; although that project has not progressed far beyond prototype for other reasons, the idea seems sound.

Other categories of opportunity involving computing and ICT are those in which access to information is increased (Respondent 4, Respondent 5, Respondent 14), or those in which a lack of experts can be compensated for (Respondent 19).

5 Obstacles

In this section we try to identify the main bottlenecks for innovation in Uganda, based on the experiences of our informants.

5.1 Reluctant entrepreneurs

A common observation we made while interviewing innovators, particularly graduates, was that they would prefer not to be innovating. The ultimate goal is commonly to find a job, preferably in one of the professions. There are multiple reasons for this. One is to do with family expectations, having sponsored a student through their university education, they expect some return on their investment. The graduate in this case also has responsibilities in the eyes of the family to financially support younger family members. Another reason concerns the unpredictability of life in Uganda, which naturally draws people to stable positions which would give them security. The innovation process is typically higher risk and hence not very attractive in this regard. Hence we find that people who are innovating have a high chance of abandoning the project if they offered a job. This was the experience for example with the SchoolMaster and WinSenga teams.

The expectations of individuals can also be unrealistically high, particularly as it is easy to make rapid apparent progress in the form of a prototype, leading to the idea that success can be obtained in a matter of weeks or months. This is further reinforced by hackathons and bootcamps which have durations of only a few days. After such an event, and when the process of rolling out the new technology inevitably takes place on a much longer time scale, those expectations are broken. Innovators are unprepared for the long haul, and again abandon the project. Respondent 3 of Digital Solutions estimates a two year minimum period for any innovation to start gaining traction; Respondent 4 of UNICEF estimates three years. This is beyond the planning time frame of most graduates (and some incubators, as we note below).

Another issue with reluctance to be entrepreneurial comes from the need to build a team. We frequently encountered trust issues in our interview. People are hesitant to expand their team to include others with necessary skills, for fear of those people stealing the idea. Sometimes this fear is justified, particularly since there is a very weak legal framework in Uganda for protecting intellectual property or enforcing nondisclosure agreement.

5.2 Entrepreneurial skills gap

From mentors, one of the most frequently identified issues was that innovators are missing core innovation skills. By this, we mean for example the ability to identify opportunities and risks, create business plans, or manage their projects financially. Mara Launchpad, for example, rejects many applications because the business plan is incoherent. We note that the skills gap is not as serious a problem in terms of technical abilities: teams we spoke to did not have significant

difficulty in dealing with computing or engineering methodologies. Teams lacking technical skills invariably also lacked business knowhow; viable business models are scarcer than new technical concepts.

Beyond formal entrepreneurial skills such as financial management, mentors also identified more general missing qualities such as the determination or resourcefulness to see through a long and complex project filled with uncertainty. We can understand this in the context of innovators (particularly young innovators) who are primarily focused on getting a job, or who have several projects running at once and are constantly in the process of dropping those which seem to be unproductive in favor of others which they perceive as doing better.

5.3 Inaccessible customers

We have seen cases in which appropriate, carefully thought out, practical solutions are offered to potential users who like the idea in principle but did not adopt them. This is especially true of public sector users, in which simply too much inertia, disorganization, and corruption for newcomers without substantial funding to be able to make an impact. For example, in the valley dam monitoring project of Respondent 17, individual government staff in the Ministry of Water, Lands and Environment expressed enthusiasm, backed up by positive press coverage, though the overall response was cold; there was no effort by the Ministry to entertain the idea officially. This left the impression of the door being closed to home-grown solutions.

Although the most intransigent customers in Uganda are in the public sector, the private sector is also frequently difficult. For example, while marketing the SchoolMaster project, the team found that the information technology managers within schools would demand a bribe before they would recommend the system to headmasters. As another example, the Mwoto Stoves team had reached an agreement with the management of a large sugar plantation that their stoves would be offered on loan to plantation workers, who would then pay back the loan on salary deductions. However, staff in the company's welfare department would also require bribes to implement this, even though they had already been instructed to do so by their superiors.

This type of resistance from potential customers is not only about gatekeepers looking for bribes. There can be parties who benefit from the status quo and stand to lose out if the new idea is adopted—even if that technology solves a problem for others. For example when developing crop disease survey technology, the team identified a risk to the project in the form of surveyors who are currently paid per diems and transport allowances to do their job with the traditional paper-based system. Even though the proposed technology has the potential to cut the overall budget requirement and provide more reliable survey data, the individuals who may lose out from this technology have significant influence within the organization which would be commissioning it.

Personal connections are needed in order to get things done, which can be another barrier to innovation. For example the food science incubation centre have been able to get produce

stocked in local supermarkets, and while there is no suggestion of bribes being required to get this done, it does require some form of acquaintance with management.

Some customers are interested but unable to pay. For example, the SchoolMaster system was developed by a team of five people; given the costs incurred while developing the project, this team have difficulty getting the price down low enough to be very attractive. For this reason some companies look outside Uganda altogether, such as Digital Solutions.

A converse problem is of end users appearing to be interested, but for reasons not related to the innovation. Respondent 5, in connection with his experience in ICT4MPower, mentions the risks of misinterpreting the enthusiasm of those involved in trials of some technology: they may be primarily interested in a free smartphone, for example.

5.4 Pilotitis

While we have seen that there is certainly no shortage of ideas, and that many of these ideas reach a prototype stage, there is a clear difficulty in scaling up from prototype to full deployment. All the incubators we spoke to reported great success in terms of developing prototypes. The Software Incubation Centre might have developed as many as a hundred proof-of-concept ideas, although only one or two ultimately looked commercially viable.

Respondent 4 of UNICEF describes how this can set back progress altogether. In the field of medical information systems in Uganda, a situation of 'pilotitis' has arisen in which a proliferation of different, incompatible systems are tried on a small scale across the country. When trials are run in a single district, or just a few health centres, they expose public health workers to some new technology, though without provision for long term support. This can effectively block better conceived, better supported and longer-term projects.

The emphasis on prototypes is reinforced by events such as hackathons and bootcamps, which generate enthusiasm (and more prototypes) in a time frame of a few days. Respondent 15 of ThoughtWorks felt that events such as hackathons are mainly useful only as social events and for idea-sharing. Respondent 24 of Hive CoLab, who has been involved in the organization of several such events, also identified the challenge of continuity.

It is not just individuals who have unrealistic expectations of quick progress. This emphasis on fast results is also the case for incubators. Respondent 3 of Digital Solutions, who has had much experience both with developing his own projects and in providing mentorship to incubators in Uganda, reckons on two years being the minimum time frame for developing and rolling out a new technology-based idea. However, he points out that most incubators have a shorter time frame. Respondent 4 estimates a three year minimum to go from concept to deployment at scale in Uganda.

Academic mentorship has the particular problem of formally ending upon completion of a particular degree. Academic requirements, e.g. for an MSc dissertation, are very different from

the needs to roll out a new idea in order for it to have any practical impact. Respondent 24 of Hive CoLab described the lack of continuity with academic preparation of graduates in Uganda. This is true of internships and work placements as well as dissertations—the potential to follow up on early-stage work in order to have more practical impact is lost. The overall effect is then to devote much academic expertise to supervising the creation of yet more prototypes. This varies across the different academic units, however: whereas projects in computing are likely to end in early stage proof of concept or prototypes, food science does more to develop student projects towards actual community impact.

5.5 Mismatched mentors

There are a few ways in which we heard about the relationship between innovators and mentors going wrong. First, mentors can be spread thinly. There might be a small pool of experts dealing with several projects, and each expert may have quite limited time due to their other commitments; this was the experience of Respondent 3 of Digital Solutions, for example, when providing supervision in the Software Incubation Centre. This is particularly a risk for incubators which charge a fee to each project team, as there is a financial incentive to bring many groups on board and stretch the available resources. This same effect happens in Makerere University, where courses are oversubscribed. Faculty in Makerere might be supervising more than twenty different student projects at any one time, in addition to their teaching, administration and research duties. Hence the amount of time that a faculty member devotes to any one student project might work out as being no more than a 30 minute meeting every few weeks.

When the young innovators themselves are missing several key skills, as identified above, this is a problem. Furthermore, people may in fact need several types of mentorship—marketing, accounting, legal—and the provision of a single mentor might not meet all their needs.

The second type of problem with mentors is to do with a mismatch of expectations between team members and mentors. For example, Respondent 16 of the Microsoft Innovation Centre describes friction with mentors who expect profit sharing in the case of the teams that they mentor. The WinSenga team had problems with their mentors after winning a cash prize: the mentors felt entitled to a cut, though the team members felt that they had done all the 'real work'. Furthermore, from the perspective of MIC the mentors had already been paid for their services.

Respondent 9 describes more issues of a similar form. He explained that student teams might feel that a particular supervisor had been imposed on them, as they had no choice in who was assigned to them. If the supervisor expects to have some managerial influence in return for their time and advice, the relationship becomes more complex. In general, mentors' motives might not in fact be compatible with those of the groups they are mentoring. Companies who have released staff to work with an incubator can treat the exercise as a low cost form of research and development, or will get mentees to work on company projects in the hopes of a job offer.

5.6 Other problems

- Bureaucracy is a problem in other respects than the barriers to access mentioned above. There is also difficulty in terms of accessing capital, exporting products or importing materials, or carrying out other necessary processes. For example, the WinSenga team are attempting clinical trials of their system, but report that the requirements for gaining approval are convoluted.
- Perceived value is an issue in Uganda, where people can see imported products as fundamentally better. This can be overcome in time with a more suitable product, as we heard from the local fabricators who are able to make more robust versions of equipment such as power regulators than would be available imported at a similar price. The issue is exacerbated by inferior packaging and marketing (Respondent 12).
- Young innovators are naïve and have unrealistic expectations (Respondent 4, Respondent 2); we expand on this in the next section.
- There is not much strategic provision for innovation in Makerere or the country at large. Perhaps there is not much belief that valuable innovations will emerge. Respondent 12 observed that about the only support he received from Makerere was office space.
- Protection of intellectual property rights was mentioned as a possible problem (Respondent 16, Respondent 13).
- Informal innovators need cash flow to advertise. However we found a skepticism of innovation or loans (Respondent 10), given previous examples of predatory or exploitative innovation funds.

We have tried to highlight the forms of obstacle particularly relevant to Uganda (and by extension, other African or developing countries). Naturally, however, there are also the same problems which beset innovation in the developed world. Respondent 3 is one of the informants who discusses these—the challenges of finding the right partners, hiring the right staff, and identifying opportunities with the right balance of risk and reward.

6 Lessons for innovation support

6.1 Selection and cultivation of innovators

First, a synthesis of comments from our interviewees; then a short discussion of our findings, leading to some suggestions as to support practices that could improve the effectiveness of support for innovation and raise the portion that can be brought to scale sustainably.

- Aspiring innovators lack the requisite technical skills (Respondent 22, Respondent 5, Respondent 7, Respondent 4); they also lack business and entrepreneurship knowhow (Respondent 24, Respondent 1, Respondent 8), though they often do not apply the teaching they get (Respondent 15, Respondent 6).

- Innovators want immediate returns (Respondent 2); they expect easy gains yet two years is the minimum time required (Respondent 3); hackathons and bootcamps create the wrong mindset (Respondent 15); there is a lack of follow-up after the prizes are announced (Respondent 24).

- Some entrepreneurs get demotivated as their teammates take day jobs (Respondent 14); when one founder took a paying job, the other had to quit his job to keep the project moving forward (Respondent 20); incubatees viewed their start-ups as placeholders while they searched for jobs (Respondent 9).

- Students' and graduates' families pressure them to get conventional jobs (Respondent 9); parents don't view start-ups as gainful employment (Respondent 22).

- The perseverance to reach a minimum viable product is critical "so that all is not lost" (Respondent 23); it can be done with time (Respondent 7, Respondent 22, Respondent 5); but persistent sustained support to the innovators is crucial (Respondent 6).

- Those who have persevered are often engaged in practical trades where they earn their living (Respondent 10, Respondent 11): these people are naturally focused on resilience, solving problems, doing it sustainably—not on projects that innovation funds focus on (maybe because they work in the informal economy, can't speak English fluently, have few educational qualifications etc.)

Several of our informants involved with mentorship stressed that innovators were held back by their lack of technical and entrepreneurship skills. As Respondent 24 observed (and others echoed), many aspiring innovators are also missing the personal qualities of risk-taking, strategic thinking and perseverance. There is a degree of naivete about the amount of time and energy needed to realize the fruits of an innovation, often compounded by a conviction that if they demonstrate a better mousetrap in prototype, the world will beat a path to their door, chequebook in hand. Hackathons and contests that reward slick concept presentations only

reinforce this misunderstanding. In fact, winning a USD 50,000 award from Microsoft has done more to attract hangers-on and parasites to the WinSenga project than to accelerate its development—to the point where the founders now believe themselves to be short of funding!

Many finalists and recent graduates view their sojourn in incubators as a pastime on the way to a salaried white-collar job; they leave teammates and innovation behind as soon as the job is secured. From this perspective, their willing participation in Kampala's frequent bootcamps and sponsored competitions reminds one of how the unemployed are frequent purchasers of lottery tickets. And here, the students may even get a certificate they can staple to their CV for the next job application. The feeling that time spent developing innovations in incubators is temporary may also partly account for incubatees' observed tendency not to apply the training they receive during that time.

Family pressures are at the root of this behavior: parents are eager to eager to see some return on their 'investment' in tuition, and for the new graduates to contribute financially to the education of their brothers, sisters and cousins. Even as they acknowledge the risks in their own livelihoods (e.g. droughts, floods, loss of contracts or essential assets), students' parents are not accustomed to viewing start-ups as gainful work. In contrast, skilled and semi-skilled workers in the informal industrial sector are not burdened with such expectations.

In this environment, there are some methods that can be applied in the selection and development of innovators to mitigate these challenges:

1. Innovators should be encouraged to view their activity as gainful work, like farming, that carries risk yet nonetheless produces tangible results when done with good planning, discipline, perseverance, pragmatism and requisite knowhow.
2. Work plans should feature short term checkpoints that can be assessed without ambiguity (e.g. prototype demonstrations, sales funnels and agreements, financial models) and whose passage measures progress.
3. Innovators should avoid participating in hackathons and be discouraged from entering contests that do not advance them toward the next checkpoint.
4. When selecting innovators to be supported,
    1. Consider candidates who have established themselves in the informal industrial sector;
    2. Reject candidates/teams who lack the technical skills to build their prototypes themselves;
    3. Test the writing skills of educated candidates;
    4. Prefer proven innovators (who have already demonstrated the necessary skills and character) and candidates who have some income security.

5. Should innovators receiving financial support be bonded?
6. Fund training on as-needed basis for basic business practices such as keeping journal accounts, financial modeling and scenario generation, business modeling and competitive differentiation. Drill the incubatees in the use of such training.
7. Facilitate periodic networking events that bring together active innovators, proven innovators, active business mentors, current and prospective customers/users.
8. When an innovator is offered a job that may distract them from their innovation project, negotiate with the employer to ensure they will continue to have protected time for their project.

6.2 The role of partners

For the purposes of this section, partners means funders and institutional partners such as NGOs, universities and government departments as well as individual technical consultants and business mentors.

As in the previous section we start with a synthesis of comments from out informants, followed by discussion and some suggestions for ensuring effective partner contributions.

- Supervisors expected a management role and shared ownership; students felt they were imposed on them (Respondent 9); mentors are hard to round up in sufficient numbers and may have inappropriate expectations (Respondent 16); Mara Launchpad arranges a speed-dating exercise to match mentors to incubatees (Respondent 8).
- Expert technical training is expensive and needs repeat engagement to ensure it is applied (Respondent 15, Respondent 6, Respondent 21); business mentors are busy executives who sometimes miss meetings (Respondent 8); Ugandans work better with mentors who are physically present, not "virtual" (Respondent 2); well-meant but naïve sales mentoring led to concept pilfering and a lost contract (Respondent 14, personal communication).
- Incubatees benefit from having a space that's conducive to socialising and exchanging ideas with each other (Respondent 9); different incubators can complement each other's service but [for mentoring] this should be transparent (Respondent 16);
- Individual donors and local partners have helped greatly with donations of services and equipment (Respondent 7), and with training and deployment support (Respondent 4); trustworthy partners and reliable suppliers have been indispensable to the success of some innovative ventures (Respondent 23, Respondent 3); strategic partnerships can help scale locally (Respondent 6) and internationally (Respondent 5, Respondent 4).

- Makerere University has provided facilities, office space and endorsements but takes no tangible interest in supporting innovation (Respondent 6, Respondent 12, Respondent 7) and is extremely slow and bureaucratic (Respondent 25); its institutional links to industry are weak (Respondent 24); in fact the policy seeking 45% of any business stemming from a thesis may deter development (Respondent 2); yet innovators say they benefit from University-hosted programmes (Respondent 14, Respondent 12); and the university is an excellent source of contacts for field and technical support (Respondent 5). Research degree programmes can be harnessed as a source of ideas and expertise (Respondent 21).
- The Ministry of Trade and Uganda Investment Authority have given no business development support for newly launched food products (Respondent 13); the government of Uganda has no policy or incentives for innovation (Respondent 16) such as support for local producers (Respondent 12); certain ministries are too bureaucratic and lack dynamism (Respondent 24) or have even been captured by unproductive, time-wasting consultants (Respondent 4, personal communication). The World Bank funding to KASSIDA (Katwe Small Scale Industries Development Association) was similarly captured by generals and ministers who spent it on workshops in 5-star hotels and acquisition of resort land, with negligible resources going to the innovators themselves ("we only got sodas and samosas"—Respondent 10).
- Involve critical-path partners (e.g. Ministry of Health) in decision making—in concert with other (paying) stakeholders (Respondent 4), otherwise personality conflicts may block progress (Respondent 5); individual government officials applaud innovations but concentrate on "bigger fish" (Respondent 17); vested interests (suppliers and beneficiaries of their kickbacks) can skew or prevent validation of the business case (Respondent 19).

Many interviewees report that individual mentors, technical consultants, donors and partners have been instrumental in advancing innovations through development and trial—particularly when their contributions focus on a single step or goal. However, the record of effective contribution from institutional and governmental partners is much patchier and seems to require a rare degree of patience and strategic management. Such steadiness of purpose and strategy seems so uncommon that a significant number—perhaps a majority—of our informants, would apparently dispense with university and government support if they could. Several who could, did.

At both levels, a lack of clear expectations between innovators and their counterparties can lead to failure and resentment. So a mechanism of getting candid feedback and using it calmly is a necessary ingredient for successful partnerships at both levels.

In that spirit, we identify below some methods that can be applied to get the best return on the investments made by partners in innovation.

1. Pay for expert technical consultants and business mentors, using contracts to document the obligations of each party.
2. Retain successful innovators as mentors as they can swell the ranks of hard-to-hire resources.
3. Encourage meaningful local contributions and donations by giving them public thanks and acknowledgement.
4. Keep university administration off the critical path for individual innovation project milestones.
5. Consider government dynamics, i.e. ministerial constraints and personal objectives, in the planning of innovation deployment and scaling-up.
6. Use feedback from incubatees to monitor and improve the impact of training and mentoring; use anonymous community feedback tools such as U-Report and mTrac to monitor and improve institutional service delivery.

6.3 Methods for development and implementation support

For this discussion, we define innovation to include the implementation of the new product or practice by a majority of its beneficiaries, or at least a significant plurality—because an innovation that is not used has really not come into existence. We now consider the RAN project's processes for supporting innovation.

As before, first a synthesis of comments from our interviews:

- The most successful or promising innovators solve simple problems: replacement of imported transformers and welding machines with local products more resistant to voltage fluctuations (Respondent 10); the high cost of getting up-to-date information about their children's school activity (Respondent 22); patients receiving different treatments for the same diagnosis (Heather Hume); deriving a saleable product from mangoes that would otherwise rot (Respondent 13); reducing the cost of supporting freeloaders and uncommitted students (Respondent 6, Respondent 8); reporting the disease and patient caseload in up-country districts (Respondent 5).
- The solution for a problem involves a business model, i.e. the mechanism whereby end users "pull" the solution through the innovator's network of suppliers, assemblers or integrators, marketing and sales, distribution and support channels, in a way that each party has an incentive to participate. The innovation failures we learned of lacked some component of a viable business model: paying for the purchase and maintenance of the rural valley water-level monitor (Respondent 17); rebuilding the entire supply chain in order to sell local sunflower oil (Respondent 12); persuading rural women to save UGX

35,000 (USD 14), then switch from buying charcoal to buying wood (Respondent 18); paying for operation and support of electronic patient record systems (Respondent 5).

- Business mentors are in short supply (Respondent 16); sometimes they fail to check end user value (Respondent 25); and they seldom address product quality (Respondent 2) or scaled-up deployment (Respondent 4).
- Financing is often sought for misguided purposes: creating mobile apps not businesses (Respondent 3); training bootcamps (Respondent 15); mass marketing (Respondent 6)—and available funds are often spent unproductively: workshops, sodas and samosas (Respondent 10); mercenary mentors and subcontractors (Respondent 20).
- Many innovations to stall after an apparently successful pilot trial. (In fact, almost anything can be successfully trialled given price incentives or a large amount of stakeholder encouragement, user training and support—but when these resources are withdrawn, users stop using the new product or stop pulling the new service through the delivery system.) Small innovators often don't anticipate the difficulty of making unforced sales or getting voluntary users (Respondent 14, Respondent 19); and (on a smaller scale than big organisations) are also vulnerable to this "pilotitis" (Respondent 4).
- Project and incubator managers may satisfy themselves with ambiguous progress measurements (Respondent 5) or may relax their own criteria for support (Respondent 2, Respondent 24).
- There is a very large local supply of aspiring entrepreneurs with concepts to pitch. Resilient incubators manage their cash flow carefully (Respondent 8, Respondent 24) and dole out incubatee support—both financial and in-kind—using checkpoints and conditions (Respondent 6).

Each incubator, and indeed each College and University, as well as each large development agency, applies a philosophy or a process in its attempts to create and deploy beneficial innovations. However the local innovation philosophies and processes seen in operation in Uganda are often the fruit of a single individual or a small group—so they are impermanent, like spoken words. This makes improvement difficult. One shrewd Ugandan has observed that a general philosophy is to "take the opportunity" to prosper today, leaving next week's challenges to next week. The findings from our interviews were often consistent with that short-term outlook.

Edward Deming, the pioneer of quality analysis, observed that if an organization produces defective or low-quality outputs, the problem is invariably to be found in the production system and not in the intentions of the workers. He showed that continuous output quality improvements could be made by measuring inputs and yields at each step of the production process, then changing the process to reduce deficiencies at these intermediate points.

Over the past 40 years, venture capitalists have applied this philosophy to the production of innovations, with two major results. First, by developing and applying technology, the industry has shown its value in making the American society resilient to economic and social shocks such as the huge increase in energy costs since 1973 and the telecoms-enabled offshoring of many service and manufacturing industries since the late 1980s. (One thinks of wind and solar power, hybrid vehicles, smart grids; the flowering of higher education, financial and entertainment industries.)

The other major result is a generally accepted process for bringing innovations from the stage of first conception to wide deployment in the target community. A broad consensus has emerged about the definition and measurement of intermediate checkpoints in the innovation process. In localizing the innovation system to Uganda, we can base on this consensus, then adopt measurements and correctives that correspond to the local problems of production. If we localize the innovation-production system in Uganda by making continuous improvements, the RAN project has an excellent chance of building greater resilience here to the 'thousand natural shocks that flesh is heir to'.

Building on the authors' and their informants' experience with local innovation systems and incubators, we thus identify several support process features that could raise the yield of successful RAN endeavors.

1. For innovation teams, make technical consulting, business mentoring and financial support conditional on passing checkpoints on an agreed schedule. Extend the support incrementally, checkpoint by checkpoint. A majority of funds will be needed for the later stages of supported innovations.
2. Require all innovation teams to produce and defend a business model for their solution. The business model must show how full-scale in-service sustainability is achieved.
3. Get feedback on candidate innovators' business models from an independent review board.
4. Do not demonstrate an innovative product or service to a prospective external partner or client until it looks as good as an imported solution.
5. In trials and pilot deployments,
    1. Identify and exploit any 'installed base' of related products or services over which RAN or a strategic partner has influence.
    2. Test not only the technical performance of the innovation, but also the business model for the solution.
6. For scaling up, get matching financial contributions from a strategic partner—NGO, institution, government or industry.

7 Conclusions

Uganda (and all of East Africa) has many resilience problems that are obstacles to social and economic development—and also a vibrant if somewhat unsystematic community of innovators. The RAN project offers a new, less ideological, more empirical and more locally based approach to using resources in and around the university community to solve these problems.

This report has attempted to follow the RAN and HESN principles of developing evidence-based interventions for development. On the basis of our investigations and analysis, we believe it is possible to avoid some of the commonly experienced pitfalls of innovation that have happened here.

We believe also that a number of support methods and practices, identified in the section above, can be applied in the context of the RAN project to increase the portion of technical and social innovations that succeed in benefiting large numbers of Ugandans.

The common theme of these suggestions is to proceed with a mindset of continuous improvement. In other words, we do not pretend to promulgate commandments that should be inscribed in stone. Rather, we have attempted to distil the knowledge and wisdom of our many informants to arrive at concrete suggestions that can provide a measure of improvement and be refined in their turn on the basis of experience.

In that spirit, we look forward to receiving feedback on this report and to continuing the endeavour to improve the outcomes for innovation in Uganda.

8 Appendix 1: Interview guides

8.1 Innovators

8.1.1 Pre-interview

Explain to the interviewee the background of the study, and the intention to find out about the experiences of innovators in Uganda. In particular, explain that we want to know what types of innovations have been possible, what progress is typically made, and what are the obstacles holding innovators back. Confirm with the interviewee in general terms the project or idea that they have worked on, and ensure that it is relevant to the aims of the study.

8.1.2 Interview questions

[Note: these questions are a rough guide intended to prompt open-ended feedback; the responses might prompt follow-up questions specific to each case.]

1. Tell us in some more detail about your project(s).
2. If your idea is successful, who will benefit, and in what way?
3. What stage are you at with your work on this/these project(s)?
    - It is still a concept.
    - There has been some prototype or proof of concept.
    - Preliminary trials with end users.
    - Extensive trials with end users.
    - Full deployment; the idea has been adopted by end users and is now in routine use.
4. If you have trialled your ideas with the types of people you intend to be the end users, what was their reaction? Do you have any specific anecdotes to share about these experiences?
5. What resources did you have access to in order to help you get this far? Were they helpful?
6. If the project is not at a final stage, what are the factors holding it back? Can you explain why those factors were a problem, giving any specific experiences where possible?
    - Lack of some necessary equipment or resource?
    - Lack of mentorship or advice? / Inability to act on mentors' recommendations?

- Lack of interest from potential users? / Inability of users to pay a viable price?
- Personal circumstances? / Conflicting personal priorities?
- Bureaucracy?
- Technological issues?
- Changing market or competitive environment?
- Anything else?

7. What types of things might help innovators like yourself to make more progress in general?

8.2 Mentors

8.2.1 Pre-interview

Explain to the interviewee the background of the study, and the intention to find out about the experiences of innovators in Uganda. In particular, explain that we want to know what types of innovations have been possible, what progress is typically made, and what are the obstacles holding innovators back.

8.2.2 Interview questions

[Note: these questions are a rough guide intended to prompt open-ended feedback; the responses might prompt follow-up questions specific to each case.]

1. Tell us in some more detail about your field of expertise and some examples of the projects you mentor.
2. Tell us about the typical background of the people you mentor. Are there particular innovation skills (e.g. creative, technical or strategic) that you find are often strengths, or any that you tend to find are weaknesses?
3. What stages have the projects under your guidance reached? [Answer for just a representative sample if many projects.]
    - It is still a concept.
    - There has been some prototype or proof of concept.
    - Preliminary trials with end users.
    - Extensive trials with end users.
    - Full deployment; the idea has been adopted by end users and is now in routine

use.

4. How much of your input do you find is usually involved in forming the concept of an innovation? Do you find that innovators come to you with strong, novel concepts and just need support with implementation, or do they need more fundamental guidance in forming the basic idea?

5. After the concept stage, what kind of input do the teams or individuals under your mentorship require from you to make progress? Are they mostly self-reliant and just need suggestions about possibilities? Or is detailed step-by-step guidance on most aspects usually required?

6. When your projects do not reach at the full deployment stage, what factors have you experienced holding them back? Can you explain why those factors were a problem, giving any specific experiences where possible?

    - Lack of some necessary equipment or resource?
    - Innovators' inability to act on your recommendations? / Some other skill or quality lacking in the innovators?
    - Your inability to devote enough time to mentoring the project?
    - Lack of interest from potential users? / Inability of users to pay a viable price?
    - Personal circumstances or conflicting personal priorities of the innovators?
    - Bureaucracy?
    - Technological issues?
    - Changing market or competitive environment?
    - Anything else?

7. What types of support do you think might help Ugandan innovators or their mentors to make more progress in general?

9 Appendix 2: Interview notes

9.1 Respondent 1

Management & Technology Advisory Consultant
Member of Review Board, Software Business Incubation Programme

9.1.1 Background

The Respondent is a management consultant in technology, with a background in numerous projects including software business incubation programs at Makerere College of Computing and Information Technology, engagements on data mining and business intelligence, finance, technology and business process outsourcing in both Uganda and Rwanda.

He has also been an associate consultant with Deloitte Uganda under their Technology Advisory team where together, were able to carry out a Business Strategy Viability Assessment. This was done in order to provide an overall strategic plan, technical review and direction for a technological company in line with the goals to grow their institution.

The Respondent has carried out research and assessments on new product development and innovators as well as projects in areas such as software business incubation. This has given him diverse knowledge and exposure on both local and international fronts regarding technological innovation and development in Uganda. With international organizations such as the United Nations, Huawei and Ericsson. His experience has thus enabled him to undertake diverse professional initiatives to brood innovators and has taken part in many tech-developmental projects on the local scene.

Another project he has been involved with is the United Nations Global Pulse, which is an initiative to harness new open data resources to detect in real-time when populations are changing their collective behavior in response to humanitarian crises and natural disasters. The Pulse Lab in Kampala is to develop a real-time data, open source and technological tools kit for crisis impact monitoring for decision making in government.

Patrick also sits on the review board for the Software Business Incubation Programme at Makerere University.

9.1.2 Innovators

He looks to mentor individuals that are technologically acquainted, self motivated, creative and looking for continual development for their innovation/ product. He chooses to lie on the idea that they may be lacking on the commercial side and legal understanding of their projects thus assists them in those areas and leaves their stronger drive for scientifically related issues to run all the technological aspects and concepts of the business.

9.1.3 Input in concept formation

He sighted that innovators mainly come to him with original concepts thus he only helps with supervision and formation of the idea to sprouting level, alignment and possible financing.

9.1.4 Stages of progress

Projects under the Respondent 's guidance cut across all levels of development starting from small concept levels to full deployment of the idea and its adoption of end udders on a day to day basis. Examples of these include:

- Deloitte Uganda (Technical review of client): Full deployment; the idea has been adopted by end users and is now in routine use.
- International Telecommunications Union (BPO, Data Mining & Finance in Tech projects): Preliminary trials with end users applied.
- Airtel Uganda (new product development/ innovations to implement International Roaming/ SMS/WiMax/LTE as new products in telecommunications): Full deployment; the idea has been adopted by end users and is now in routine use.
- UN Global Pulse project: there has been some prototype or proof of concept on stage I (planning phase) of the project. The project is currently fund-raising for the stage II (implementation phase) of the project.

9.1.5 Obstacles

- Conceptualizing ideas for general understanding
- Limited creativity
- Poor public perception of goods/ innovations
- Inability to incorporate useful software into existing businesses
- Lack of patience for businesses to sprout by innovators
- Lack of lack of locations to run projects
- Inadequate financial ability for incubators to fund mentees
- Political barriers or bureaucracies
- Lack of exit strategies for incubatees

9.2 Respondent 2

Incubator Researcher, College of Engineering, Design, Art and Technology, Makerere

University

9.2.1 Background

The Respondent has an engineering background, having an undergraduate degree in engineering from Makerere University College of Engineering Design Art and Technology (CEDAT) and a masters degree in Technological Innovation and Industrial Development, also at Makerere. The Respondent is neither an innovator or a mentor, but has researched incubators during MSc studies, studying the environment in Uganda, Kenya and Tanzania. In the years leading to this interview the Respondent has been exposed to numerous incubators such as the NaiLab in Nairobi, Kenya, and incubators set up at the University of Nairobi and University of Dar es Salaam. He is currently part of a team conducting a feasibility study on incubators on behalf of Uganda Investment Authority which is thinking of starting an incubator. UIA is concerned by why businesses fail after in their first year. He is also working on a renewable energy project in a virtual incubator at CEDAT funded by the Norwegian Government. The mentors are PhD holders at the college who help incubatees with mentoring, seed capital and contacts of venture capitalists.

The Respondent, having been to the archives at his college, saw many projects written by final year students and masters or PhD research students, he saw these 'gather dust' in the store rooms. He feels there is a need to commercialize projects, and that each faculty should have a commercial office. His aspiration is for CEDAT to have its own incubator. At the moment a 'virtual incubator' exists where incubates work away from the college, liaise on line and only meet once in a while. There is no physical space where technologies can be built. He does not think Ugandans are ready for virtual incubators, but feels they work better in a physical area with physical mentoring.

9.2.2 Obstacles

The Respondent observed that the mentees he has interacted with lack basic entrepreneurial knowledge to help their products kick off such as marketing skills, business skills, end user customisation, and product presentation e.g. surface finishing, logos, branding and packaging.

The failure to make customizable software to meet the demands of end users has created a negative perception of technological advancement as the majority of the population cannot operate these highly technical software applications. For example some technologies are created for upcountry users but one has to operate a high end phone to benefit from an application.

The Respondent also sighted the lack of patience among young entrepreneurs to let their product gradually mature, instead looking towards immediate returns instead of working long term. When they do not realize quick returns, founder members abandon projects, disintegrating the teams, hence failure of innovations to take off.

He also observed that criteria set by many incubators are not followed throughout the process

even at the point of candidate selection. Some incubators may lower standards to help mentees final products move past prototype stages and forgo the minimum standards set by the criteria of the incubator. This in the end fails the projects.

Political barriers and bureaucracy hinder the progress of numerous innovators to access funds and limit their ability to move their products across borders.

Some incubators will ask for large stake in a company in return for mentoring. Makerere University has a policy where a business started from a thesis written gives the University 45% shares of the company. Although it is rarely enforced, the innovators find this prohibitive.

Negative perception by the local market which will prefer imported or foreign innovations to Ugandan ones is also an obstacle. For example Riham Cola failed to impress many Ugandans merely because of perception.

9.2.3 Useful support

The Respondent does not think money is the main need of incubators. One needs a good saleable idea, a good incubator to support it, and entrepreneurial knowledge. This will enable incubatees carry on even when seed capital is exhausted. This reiterates the need for a rigorous, uncompromising screening process at the admission stage.

He also observed that mentees should continue to work with their initial incubator, mentors, universities and companies to help them fully commercialize their product if it manages to go past the stages of preliminary trials. He cited the success of the Food and Science Incubator at Makerere that enjoys a lot of college support.

Mentees should be charged rates for utilities close to the going market rates (for their use of office desks, stationary, internet and other services) in order to drive them to work harder. He believes many of the incubators are not a reflection of the real world and companies suffer when they step out of the shielded environment of such an incubator.

Ease of access to funds should be a priority to those innovators in the incubator that have already exhibited the usefulness of their product.

The in-house mentors, who may be venture capitalists or businessmen in their own right, should be given the opportunity to model these mentees to present their businesses as they would see fit to create a competitive chance for their ideas in real world situations. He also emphasizes the use of venture capitalists, who have access to funds, to provide loan opportunities to the mentees at lower rates than the commercial banks. This should however be for mentees who have had extensive successful product trials with end users.

Mentees should emphasize the finishing of products to meet national standards and be able to compete with already existing products.

Course specific incubators should be created at all levels of education within the levels of higher

education universities and technical colleges. For example, faculties should setup incubators to further advance students innovation across the various faculties to create a high level of competitiveness and lateral thinking.

He believes mentors should be more relevant e.g. seeking partnership with members of parliament or local leaders who knows more about a region and its need, hence prompting new innovations or improvement of already existing innovations to meet those needs better. Many incubatees lack knowledge of the needs in the market they are producing for, especially when designing products for rural markets. More incubators are necessary in Uganda for them to have impact; he claims the US has over 5000 incubators.

Finally, incubators should set up exit strategies for mentees whose products are past extensive trials with end users or past a given duration for a prototype to take off in the market. This will create independence as most mentees would otherwise prefer to stay under the wing of the incubator.

9.3 Respondent 3

Founder and Chief Technical Officer, Digital Solutions

9.3.1 Background

The Respondent founded Digital Solutions in 1998 after completing Computer Science degrees from prestigious universities (Princeton in the US and Cambridge in the UK). He started a software company in Uganda at a time when there was little computing expertise and the public did not have much appreciation for the value of computing. Nevertheless, he ran a successful software company that built flagship products in the market.

Digital Solutions' first major product was an internet timer called Butterfly. This application handled billing and management of internet access time in internet cafes. Butterfly dominated the internet café market in Uganda for close to 10 years. Butterfly helped establish the Company locally as a serious contender in the emerging Information Technology market in Uganda. Developing and deploying Butterfly also provided the initial staff of Digital Solutions a great learning opportunity in the software development.

The Respondent was also the pioneer head of the software innovations department, for the then faculty of computing and IT, now called Computing and IT. He recruited the first group of developers that developed Exam systems, HR systems, contributed to OpenMRS (an open source medical records system) and many mobile applications.

The Respondent also worked as a technical director for phase one of the Rockefeller project that established the first software incubation lab in Makerere University.

9.3.2 Innovations

Digital solutions' flagship product Butterfly was born out of the Respondent experience working on an ISP billing problem that was presented to him in 1995 when he visited Kampala and Nairobi. The experience gained in developing an ISP billing platform was used to develop Butterfly and there was client waiting for the solution.

The initial development of Butterfly was exclusively done by the Respondent . He later on used savings from previous billing projects to hire the first team of developers to work with him. The team continued to grow with business growth and more products were developed. Some of these projects contributed source code to large scale telecommunications applications such as Kannel—that are still in active deployment to this date.

The Respondent stated that business opportunities and their success are largely a matter of chance. Opportunities for a project show up after someone has experienced a problem and then they talk about it with another person that can help them solve it.

The strategies discussed here are also meant to provide an indication into what a success software incubation center needs to consider. A successful software incubation program can be looked at in same sphere a successful business operation.

- The Respondent highlights that he can trace his success to the nature of partners he has had, choice of employees and his determination to succeed.
- The choice of business partners, which also has some form of luck. Finding trustworthy partners takes both luck and determination.
- The need for self-denial in order to get something done. Many people trying out at entrepreneurship and give up easily when the journey gets tough.
- The choice of developers of workers or employees is very important, since they determine whether a project will be delivered on time or not. Some employees quickly add value to the business while some cannot easily contribute.
- In his opinion grades don't matter much, but someone with Fs (Failure grades) all through is likely to be problematic.
- High school background has a significant impact on the quality of employee and partner. In his opinion a good high-school determines whether someone will think through challenges well enough.
- Having an aptitude test for developers such as writing an essay about a national topical issue, helps to identify incubatees that think well.

Sometimes the gate-keepers in Ugandan organizations create an obstacle for business growth. A great opportunity however exists with businesses outside Uganda. The first successful revenues

for Digital Solutions from outside Uganda started in 2003. It took 3 years to achieve this. For the past 4 years, most of the revenue for DS has been foreign. Business revenues do not have to be limited to Uganda. Partners are key for making such international engagements a success.

9.3.3 Obstacles

According to the Respondent, businesses and organizational approaches to success take long to change. A business with a product may for example fail to realize that 'Item' based pricing may not help them grow. This requires a change in mindset for approaches to profitability.

Digital Solution had for example to change from unit pricing of Butterfly in order to outcompete other products that had come on the market. Instead of selling the software, butterfly was given out for free and money/revenue was made on advertising campaigns. This really worked well since the software had to work on the internet. Transforming butterfly into an advertising platform brought more revenue that per unit pricing.

The other critical issue Digital Solutions success was the ability to hire and retain high-quality developers. The Respondent realized that giving developers challenges that kept them excited about their work was useful in keeping his developers working with him for periods longer than 5 years. He gave developers a chance to technically grow and allow them a chance to try-and-fail even for tasks that he could do well himself. Giving employees a chance to try out challenging tasks allows them a chance to grow through the ranks.

9.3.4 Useful support

Experiences with the Rockefeller Software Incubation Project

The Respondent worked on the Rockefeller project as the head of software innovations department at the former faculty of computing and IT.

In the Respondent 's opinion, the Rockefeller project was mainly geared towards creating products (in particular, phone and computer applications) and indeed these were created in large numbers. This however does not interpret into businesses. The Respondent observes that when it comes to products, developers can easily do so. To have a successful business out of a product takes time at least 2 years. The Respondent states that it averagely takes two years to create a business out of a product. Incubation programs rarely have this lifespan.

Most of the projects that were created did not have traction. The project was happy to count that 50 or 100 apps were created. There was no follow-up on making the projects a business success. Making a product a business success requires more than what engineers alone can do.

4Africa

The Respondent identifies that an approach that has seemed to work well in parallel to incubation centers has been implemented by the 4Africa project created by Microsoft. 4Africa project aims to promote businesses for applications developed in Africa targeting the Windows

mobile platform. Microsoft has created a platform to support developers in Africa to write application for the Windows mobile platform through SME Online Hubs. Unlike several incubation programs that mostly support product development, Microsoft provides an extensive support program that hand-holds innovators to realize business success. In the Respondent 's opinion it takes at least 2 years for a product to grow into a business. For innovations to have business impact, a long term commitment is need to have a product grow into a profitable business.

4Africa projects have proved to have more traction than purely incubation based developments. Microsoft is also benefiting by having several applications developed for the windows mobile platform. 4Africa project is also promoting low-cost windows mobile phones in Africa with applications developed by Africans for Africa.

Another issue that seems to hinder success of most incubation centers is the assumption that mentors will work for free out of passion for the projects being implemented. The Respondent notes that mentors need to be paid since it's difficult to have mentors working or committing their time for free.

9.4 Respondent 4

Health Systems Strengthening Coordinator, UNICEF

9.4.1 Background

The Respondent holds a Bachelor of Arts Degree in English, from the University of California, Santa Barbara. He further went on to pursue studies in Economic and Political Development from Columbia University's School of International and Public Affairs in 2007. He at the outset worked in New York's UNICEF office under Sharad Sapra the then Uganda representative at UNICEF Headquarters and who had set up an innovations unit in New York. He is currently the Health Systems Strengthening Coordinator at UNICEF HQ in Uganda where he has coordinated a UNICEF effort to work with countries government to create a National Health Information System Strategy.

9.4.2 Innovations

The Respondent currently works with UNICEF Uganda and has helped set up a model under which UNICEF can engage in innovations as part of its routine program from a mold initially set up by Sharad Sapra a former Director at UNICEF. This model came to be known as Technology for Development Initiative (T4D) in Uganda and has focused on issues affecting child survival, development and protection of maternal health, general health education and sensitization about HIV, to see how innovations could be scaled down from international to national levels and has been running in Uganda for 4 years. Examples of these include: renewable energy, strengthening of technology, EMO's and a study of a biogas project running in a Karamoja school that turns

waste into energy.

9.4.3 Progress

The Respondent has set up, monitored and facilitated numerous projects throughout the years he has worked with UNICEF Uganda. The office he works with has invested heavily in technology such as solar energy, biogas and other forms of renewable energy with many teams being put in place to supervise these developments and this caught the attention of the public as well as people within UNICEF as people begun to see the potential of these projects and many continued to expand in portfolio. UNICEF took notice of this in its offices and sent in a new Executive Director to set up offices for two advisors who are based mainly in the area of innovation global monitoring and evaluation frameworks. He has managed the set up of programs such as DevTrack, U-report, RapidSMS, M-Track, Digital Drum, and a birth and deaths registry system among others which are at full deployment levels and play a major part in assisting UNICEF and the government of Uganda through the Ministry of Health in addressing issues such as disease surveillance, accountability, statistical data collection and project assessments. Some of these have received numerous awards throughout the years such as the African Development Bank's top global eHealth initiative of 2013 and one of the best inventions of 2013 by The New York Times.

9.4.4 Input in concept formation

The Respondent mentioned that UNICEF engages with government, civil society partners and individuals in community to develop and formulate concepts and programs. They take a stronger stand with working with government through the Ministry Of Health as they are the final decision makers in the entire medical regulation and implementation process country-wide. For example the joint venture with UNICEF, the government of Uganda and Uganda Telecom to improve on the effectiveness of the birth and deaths registry in Kampala through an open source approach to prevent commercialization of this tool by any of the major players.

He stated that previously most data was collected by Demographic Household Surveys (DHS) which were carried out almost every 5 years as well as MIX data which is a resource intense method of getting information and was on a 2–3 year basis. This was however transformed as soon as UNICEF noticed that with mobile phones and other devices institutions were able to receive real-time data which could be used to course correct during programs to identify problems before they could have devastating effects.

9.4.5 Input in implementation

He mentioned that two pillars have been set up and are in place as a global strategy to curb major issues of concern. Firstly was that UNICEF will play a greater supportive and strengthening role to Management Information Systems (MIS) such as the Health MIS, Education MIS etc to help and improve on accuracy of routine data received and sent to the government

Second, there was direct dialogue with the community members through mobile platforms such as anonymous SMS and U-report where individuals in these select communities would be engaged with simple yes/no questions and would receive questions and have responses sent back almost immediately as the service was toll-free. This enables government, NGO's and INGO's to monitor service delivery at these medical centres or district hospitals.

The impressive figures and effectiveness of these pillars has seen countries take up these models and adopt them in their countries following a similar model as Uganda's. Examples are that Rwanda's antenatal care for mothers has been improved, Malawi's growth and monitoring system for infants and as well inspired countries such as Afghanistan, Libya and Syria to visit the country.

9.4.6 Obstacles

He mentioned the issue of data relapses as not all the necessary feedback is received from the RapidSMS and U-Report on time for compilation but has seen a significant growth in feedback over the years, still standing at a 30% response rate. Surprisingly, the Respondent disagrees with the notion that rural mobile phone users are unable to use IT inventions as most of the health work done is rural and they use the phones effectively for reporting.

The problem of government delays on pushing for projects to be passed was an issue in ministries had a lot of bureaucracy as numerous chains of command had to be followed for an issue to be addressed.

There is a need for true engagement by government with NGO's and INGO's with more emphasis on smaller and usually ignored issues at district levels which could help be a starting point to address even bigger issues.

The Respondent has written previously about the problem of 'pilotitis', in which several competing early-stage health information systems can actually retard progress.

9.4.7 Useful Support

- Strategic partnerships should be encouraged
- Mobile Monday modules
- Development of inter-organizational information pools to avoid repetitive research

In conclusion, through the various innovations UNICEF has come up with, he is still unable to judge the best entry point for a body wishing to aid innovations. The stage that makes the most impact cannot be clearly identified according to him. Whether facilitation should be at entry level/concept at prototype or at full deployment.

He however believes strategic partnerships and linkages are a big help to fully deployed innovations not only in helping access to markets but say linkages to fabricators in china for

finishing of products which is lacking here.

He also thinks the average age of a successful innovators in the USA is 37 years, so the tendency of young entrepreneurs to think they will hit a miracle jack pot soon as their innovation is out is not realistic. Products take as long as 3 years to be successfully deployed e.g., the Family Tracing Reunification tool developed by students to reunite refugee families.

9.5 Respondent 5

Programme M&E Staff and Client-Side Implementation Manager: ICT4Mpower, DHIS2, ShifoClub

9.5.1 Innovations

- ICT4MPower—electronic medical records system developed under contract for the Uganda Government, primary for outpatient clinics but extendable to maternity and inpatient records layered on a common core system. Used in Uganda (Mukono HC4, since 2012apr with regular updates but without formal evaluation though validated through continuing use; trials under negotiation for use in Afghanistan and Turkmenistan)
- DHIS2—open-source operational data collection and reporting system used by the Uganda Ministry of Health (MoH) for national public health system management. Developed initially at the University of Oslo, now deployed in 30 countries (over half in Africa) with developers on 3 continents. (See http://www.dhis2.org/overview.)
- ShifoClub—a healthcare delivery management system that combines patient-level tracking of public health interventions such as immunisations with crowdsourced funding. Recently trialled in Amuria District.

9.5.2 Potential impact

- (ICT4MPower, ShifoClub) Patients—would have a portable digital record and could get referrals between facilities.
- (All 3) Health facilities—reporting.
- (All 3) Drugs and stock suppliers—inventory management and tracking / reporting / distribution planning.
- (All 3) MoH—better reports and aggregated measurements for HMIS and public health funding partners.

9.5.3 Stages of progress

- ICT4MPower - The system has been adopted by end users and is now in routine use at a single site; system has now been largely handed off to MoH for deployment at other sites
- DHIS2—Full deployment across all regions of Uganda (and partial or full deployment in 29 other countries, mostly in Africa).
- ShifoClub - There has been some proof of concept.

9.5.4 User reaction

ICT4MPower: Users say they love the system, especially lab results entry and reporting and MoH HMIS reporting; but they don't use the system to its full extent—for example they create a new record for each visit instead of adding to the patient's existing record.

Pharmacists somewhat resent having to work with the system since it demands entry of stock on hand and new incoming stock in addition to updating dispensing records. (Suspect that automating the drug ordering forms would not have solved this issue because drug orders have HC budget impact that has been traditionally run by seat-of-the-pants—ie hidden sophistication and complexity)

DHIS2: Most end users are district health officers, biostatisticians and Health Centre 4 directors. They were trained on DHIS2 during 2011-2012 and are motivated to use it if they want MoH to support their requests for personnel and supplies. Even so, some users totally invented the data they entered and were only caught out during the 2012 CoCIS MoH internship exercise.

ShifoClub: In the early concept trials that have taken place, users were carefully selected for openness and cooperativeness, and give good technical support. Not surprisingly, feedback is fairly positive but may not be a good predictor of larger scale experience.

9.5.5 Resources

ICT4MPower:

- Financial assistance and technical resources from Sida, for software devfelopment and project management.
- MoH—requirements, overall coordination (but they lacked resources).
- Personal contacts from Makerere (CoCIS) for trial deployment and local technical support.
- UCC (intended) network & computing resources (never materialised for unclear

reasons—concern about theft?—mistrust of MoH?—felt they were just dragged in only to contribute money instead of also contributing experience from other rural infrastructure deployments?)

DHIS2:

- Feasibility assessment from Makerere (CEDAT) and MoH.
- Financial assistance and technical resources from Norway and from CDC-Uganda (USAID) for software configuration, installation, technical support and user training.
- Project management, HMIS reporting requirements and deployment planning from MoH.

ShifoClub:

- Financial assistance and technical resources from Karolinska Instiute, Sweden for software development and project management.
- Personal contacts from Makerere (CoCIS) for trial deployment and local technical support.
- Crowdsourced donors for operational funding.

9.5.6 Obstacles

- (ICT4MPower) Personality conflicts—resulting in partial failure of management partnership, exacerbated communication problems between the 3 partners, led to antagonism between coordinators, blindness of technical coordinator to their ignorance of the local expertise and logistical issues.
- (ICT4MPower) Cultural differences
    - Led to underestimating the importance of the partner relationship and later to disrespect for each other's subject area knowledge—not playing the "long game"—now each side sees the other as a petulant child who changed the "contract", wants all the credit for the baby. Free/open source software (which should have been a point of agreement) became a point of contention. Other examples: (i) initial choice of distant rural pilot, then change of mind, (ii) contract, taking financial commitments for granted, naivety about banking arrangements, technical responsibility for servers etc.
    - (anecdote) in Somalia– resentment and jealous independence but grudging acceptance of practical changes; vs Uganda—clients were willing and welcoming to let "helpers" do work for them, then the wheels fall off when helpers leave because users aren't doing it for themselves … leading to a mutual "We're doing

it for you" sensation … the development "game" both sides play to get more rewards.

- (ShifoClub) Trust: "What happens if they skim the money?" Swedes: the contract, not the desired outcome (more outreaches)—100% transparency leaves no flexibility and you need some for the unforeseen.
- (ICT4MPower, ShifoClub) Developer push instead of customer / user pull
    - Reluctance of developers to visit users in their current environment (both sides preferred neutral-ground meetings); misinterpretation of user "interest" (they may only want a free smartphone): they fail to give detailed requirements in interviews (whereas Swedish proxy users were highly detailed but irrelevant).
    - Consequent lack of clarity about the in-service vision and practical value; assumption that users will flock to the system because it has nice software features.
- (ICT4MPower, ShifoClub) Developer mentality—Ugandan students weren't up to the initial task; contention between FoT and FCIT; Swedes (like all developers) wanted to jump into coding & assumed that EMRs (electronic medical records) were of unquestioned value (yet EMRs are useful only for chronic diseases—so Ugandans reasonably continue to see medical care as a memoryless series of disconnected episodes). The main perceived value of EMRs is to feed the weekly HMIS reports; the data flow model for referrals was consequently never tested.
- (All 3) Infrastructure—architects & coordinators jumped to conclusions about internet access, electricity, user training (eg for data entry), hardware support, theft, maintenance, …)
- (ShifoClub) - Need to work with imperfect records and missing data, eg unrecorded polio vaccinations before boosters; no baseline for evaluation of outcomes.
- (DHIS2, ICT4MPower)—Tensions between development agency and client (MoH) led to "firings" and inability to update server software.
- (All 3) Ambiguity—when we say "People are using the system," exactly what are they doing?—what exactly is the outcome of use of the system? need a detailed evaluation framework developed together with users and all stakeholders, not just software developers or funders. This has impeded scaling up because we don't know what the actual user incentives are.

9.5.7 Useful support

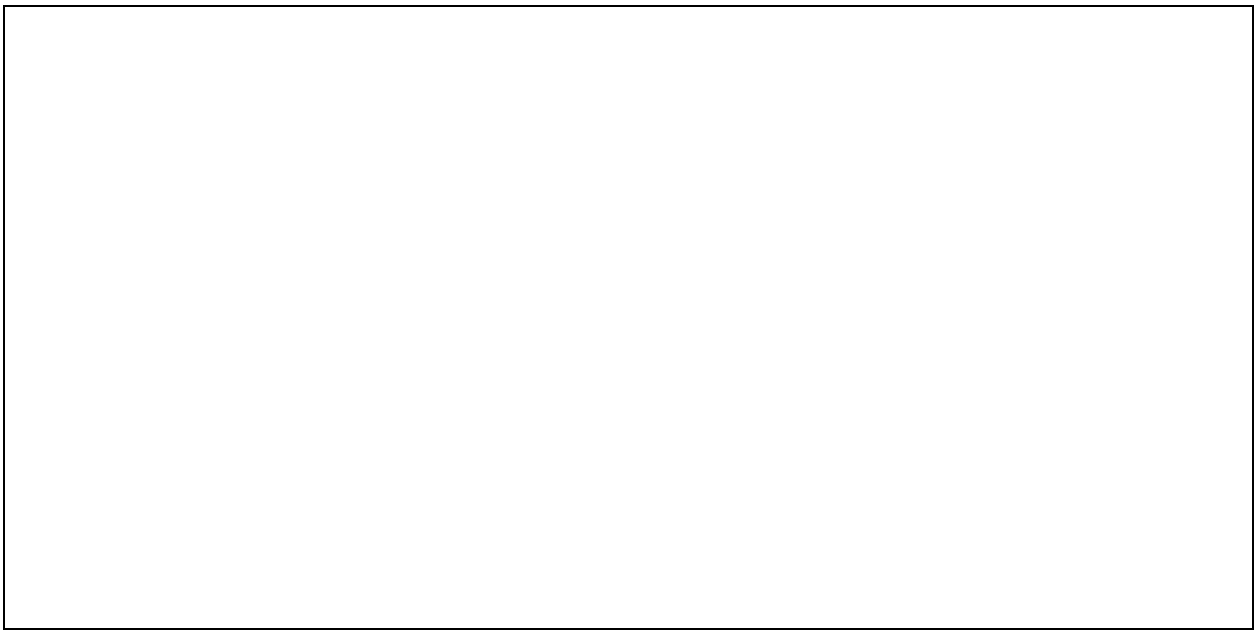

Figure 9.1 Reduced flexibility of task assignment using ShifoClub between the three people involved in rural vaccination outreaches.

- Ask whether this is entirely new (ICT4MPower, ShifoClub) or is it a mechanisation of an existing process (DHIS2 data collection). Does it make sense? Does it reduce work? Eg: HMIS 33, 105/108 (inpatient, outpatient counts), stock reports ARE useful; other HMIS forms are overkill. Implied learning: focus on improving existing processes.
- If it's truly new, how does it change the process—new device, new tasks, new input resources? And does the end justify the means? Does it necessitate defining structured job roles that were previously flexible? Does it slow people down? Does increased coverage compensate for the cost of performing additional tasks required by the system eg for reporting? Does it reduce flexibility in user tasks and roles? (Figure 1 shows how introducing a new application (Shifo) reduced the flexibility of task assignment between the 3 people involved in rural vaccination outreaches.
- Play the long game—the relationship is primordial.
- Define "profitable" or "sustainable"—different partners (funder, developer, implementor, user) have differing definitions or bottom lines and different time frames. Everyone talks financial language in the commercial marketplace; in development the stakeholders use this financial language but to their own implicit ends because the underlying incentive structure is different in development. Same words, different grammar. (Social entrepreneurship assumes you can run a "business" without traditional financial business

objectives.) The private NGO sector is just a parallel public sector financed by someone else—and it can distort markets, leading to unsustainability. Conclusion: if you're aiming to provide a public good (eg vaccinations), use the public sector—because eventually the public will have to support it. Autocratic government can be a formidable facilitator (DHIS2, China, Rwanda, Singapore).

- Beware software developer push eg ShifoClub
- DHIS2 implementation worked because the MoH controls some key user incentives; jobs, payroll, promotions. In contrast, ShifoClub funders have only the choice to stay in or walk away.
- Ask users why they will use the innovation. Sometimes it because their boss demands it and can take sanctions against laggards.

9.6 Respondent 6

Manager, Software Business Incubation Programme, College of Computing and Information Sciences, Makerere University

9.6.1 Description of innovation

The Software Business Incubation programme is now entering its 4th year of operation. Anyone is eligible who has a business concept they wish to develop and is willing to commit priority time. In practice, this has meant Makerere University students, graduates, staff and wider community. Group applications are preferred but individuals are also welcome. The business concept should use software or ICTs to solve a problem or address an opportunity in Uganda. Applicants are invited for an introductory interview to learn about them and explore their business concept. Most applicants are accepted into Stage 0 (see below) on the spot. The main intake starts in October each year, but applicants can be accepted later or earlier.

Rather than proceeding (as in most contests and many existing incubation centres) directly to software development on projects that appear original to the entrepreneurs, the SBI programme requires its applicants to function as follows.

I	a) Identify a problem in an existing enterprise that prevents it from carrying out its business more effectively, or causes it some undesired expense; or b) Identify an opportunity for the enterprise to sell an additional service or product to its existing customers, or c) Identify an opportunity for a group of individuals to save time or expense.

2	Engage the enterprise or the individuals concerned, to understand this problem or opportunity intimately, from the viewpoint of its owner(s).
3	Conceive a cost-effective solution through discussion with the enterprise or individuals concerned. Build and test a prototype solution to demonstrate proof of concept.
4	Make a business proposal, to seek financial backing and specialised mentorship.
5	Contract with the enterprise and/or with suppliers to deliver the solution.
6	Implement the solution and put it into service.

As the entrepreneurs progress through these steps, they have access to software development labs and receive regular lectures from CoCIS staff plus guest lectures from technical experts, local business people and academic staff from other colleges and universities. They are also held to a schedule of regular weekly or fortnightly coaching / tutorial meetings with SBI programme staff. As many of these aspiring entrepreneurs begin with only a business concept and have passion but no practical experience, the lectures and tutorial meetings are crucial to their progress.

The learning areas covered in the programme include customer identification, concept validation, business modelling, financial modelling and competitive analysis, costing and pricing, interview and presentation skills, elevator pitching and sales presentation, understanding investors, status reporting, basics of corporate structure, operations, contracts and intellectual property. Other programme activities include introduction to potential clients and investors, progress assessment and mentor matching. identification of and introduction to external business mentors and potential investors, records keeping, facilities management, general training coordination, and project accounting.

The key feature of the SBI programme for B2B start-ups is – sell before you build – so that only what a client is paying for gets built. Correspondingly, for B2C (consumer solutions) the prototype solution must be tested on real-world users before the programme commits financial resources. The college facilities and the available mentors are limited – and any stakeholders want to be sure these resources are marshalled to deliver commercial value. Otherwise the mentors can lose motivation.

The first 4 steps above may take several months for an entrepreneur or a group to accomplish. But the process avoids the building of solutions to the wrong problem, or to a problem that turns out not to exist for the intended clients.

The management checkpoints from conception to viable business are summarized as follows:

- First meeting: review and screening of verbal proposals are done on request from any

applicant to the programme. Accepted projects will proceed to …

- Stage 0: Project team formation and exploratory research leading to description of the new business concept, concluding with a business model and written business plan. No funding is offered to the entrepreneurs in the project team during this exploratory stage. As soon as a project team prepares its business proposal, financial plan and proof of concept, its members can request a hearing by the Incubation Review Board.
- Stage 1: Business plan approved by the Incubation Review Board. A hand-picked business mentor begins working regularly with the group, and specialized technical training or consulting may be advanced to project team as they work toward a contract with a lead customer.
- Stage 2: For B2B projects, contract signed with first customer; for B2C (business to consumer) projects, software built and agreement signed with any key supplier(s). The new start-up is incorporated and funding is offered to the project team to work toward implementation.
- Stage 3: For B2B projects, the lead customer has implemented the new product or service and begun using it; for B2C projects, the new service has gone live – giving the start-up its first revenue. The business mentor continues with frequent coaching and some additional funding is advanced to the project team.
- Stage 4: For B2B projects, lead customer has formally reviewed the performance of the new product or service, and has declared it to be satisfactory; thus is ready to recommend the new product or service to other clients. For B2C projects, sales have increased steadily for 3 months and a high-confidence date is known for positive operational cash flow. At this point the start-up should have a sales funnel of additional clients and will be able to tap conventional funding sources (e.g. bank borrowing).

As in the management of venture capital, incremental funding for each stage depends on passing the checkpoint at the end of the preceding stage, according to plan. The time allowed for each of Stages 1, 2 and 3 is normally 3 to 4 months at most. Figure 9.2↓ summarizes the progress of a successful project from proposal to established, growing business.

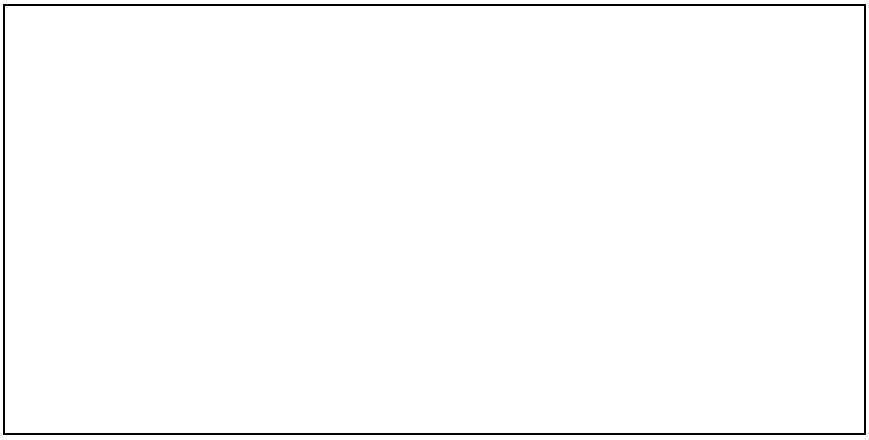

Figure 9.2 Progress of a successful B2B incubation project. Below each box is the main work done in that stage; and to the right of each box is the event that enables promotion to the next stage. Stages 1,2 and 3 should each last no more than 3-4 months.

The purposes of this process are (i) to provide frequent checkpoints for assessing the viability and progress of each start-up; and (ii) to weed out failures early, so that the very limited available funds can be focussed on those start-ups (and teams) most likely to repay investment. Originality of the entrepreneurs' idea is not the key factor: success depends mainly on execution. The process is more important than any particular business concept it incubates.

9.6.2 Potential impact

The long term goal of the SBI programme is to contribute significantly to a collection of prosperous medium-sized local enterprises providing services, products and employment to Ugandans. It is hoped that some of these enterprises will expand to neighboring East African countries.

9.6.3 Progress

Up to present, the results have been (1) training of about 250 students and graduates in practical entrepreneurship, in about 80 teams. Those who stay in contact report mainly that the programme helped them find other work (usually salaried) and excel at it. A minority have become successful independent entrepreneurs, one reported now having 20 employees.

The other results have been (2) approval of 20 business plans out of about 45 presented to the external Incubation Review Board. Of these teams that entered Stage 2, the majority disbanded when one or more members took other jobs; but 8 were legally incorporated and registered, 4 of these have attracted private financial backing, 5 have made sales and delivered the agreed service to customers, and 4 are currently going concerns in Stage 3.

In terms of SBI programme delivery, progress has consisted of a series of incremental changes that have improved the efficiency and effectiveness of the programme, as measured by the pass

rate from Stage 0 to Stage 1, from Stage 1 to Stage 2 and so on. These changes have included:

- Alignment of principal intakes with the academic year (since 2010)
- Formal legal structure within Makerere University (2011)
- Formal terms of engagement signed by entrepreneurs (2011)
- Upgrade of incubation lab computing facilities (2011)
- Increasing number and variety of guest lectures (since 2011)
- Donor funding for year-round operational support, as the Respondent is present only during the academic term (2012)
- Recruitment in CoBAMS, CEDAT in addition to CoCIS (2012)
- Commitment fee paid by incoming entrepreneurs, to help cover operating costs and weed out unserious candidates (2012)
- Addition of development partners (Global Business Labs 2012-2016, Uganda Communications Commission 2013-2014, ThoughtWorks 2013 onward)

4. User reaction

The main feedback from the incubatees has been that the programme has made them more effective workers and helped them find salaried or other work. They say the weekly face-to-face meetings with mentors are the most valuable feature of the programme.

The university affiliation (and the Makerere address) has also helped the registered start-ups approach customers and make sales.

9.6.4 Resources available

The university resources contributed to the SBI programme have been mainly in kind: office and lab space, administrative support and internet access, lab computer and network maintenance. CoCIS also reimburses a significant part the Respondent's air travel expenses between Canada and Uganda.

The main operating costs of the programme have been met by private donations: payments for year-round operational management, legal services. The Respondent is not paid any salary or per-diems by the university.

The commitment fees paid in the past year by programme participants serve mainly to cover back-up internet access and local transport costs.

The programme's business mentors, guest lecturers and review board members are all volunteers.

9.6.5 Obstacles

The commonest reason for failure of SBI entrepreneur teams is when a team member gets a conventional job. This typically leads to breakup of the team and abandonment of the start-up. A related cause of failure is that most programme participants are pursuing other projects at the same time in the hope that one of them will bring in cash. Given that few Ugandans have the financial resources to survive for even two months without income, this behaviour is understandable, but it is detrimental to starting up a new enterprise.

The shortage of financial support has obliged the SBI programme to be stingy with its start-ups (perhaps too much so) and to depend overly on part-timers and volunteers. Up until 2012, it was impossible to maintain contact with entrepreneurs from mid-June to September and from mid-December to mid-February. Consequently each new intake felt almost like a fresh start from ground zero, and contact with alumni was erratic. For a programme whose main demand from its participants is perseverance, this has been a serious challenge.

Despite many kind words and expressions of interest, there has been no government support for the SBI programme. Many government schemes for stimulating local business like Skilling Uganda, BPO, Pearl Jobs and various other job-creation initiatives look more like electoral gambits or sweetheart deals than serious economic development programmes. Sometimes they are simply misguided whims from State House.

For the SBI entrepreneurs, attempts to sell or market to government departments and agencies have yielded no success. Entrepreneurs report that potential government clients are inaccessible, or uninterested in trying alternative suppliers, or try to steer the business away from the SBI start-up to a rival who is colluding with them.

A majority of the aspiring innovators who join the SBI programme lack the programming skills to even prototype their concepts. Programming skills of CoCIS students and graduates are on average at least a year behind their European or American counterparts, though of course, the best shine with passion and would stand out anywhere. The Respondent thinks the causes are excessive class sizes and overstretched tutorial and lab support, plus the fact that many students don't give their coursework enough attention or are interested only in passing exams (not a problem unique to Uganda).

9.6.6 Useful support

Its university location has been a valuable asset for the SBI programme. It ensures a steady stream of aspiring innovators and is an easy place for them to frequent, with privileged access to research ideas and academic experts who often have other useful contacts in turn. It also confers the prestige and reputation of Uganda's oldest and best university on the programme.

The university link was instrumental in attracting Global Business Labs, a Swedish business accelerator to co-locate in CoCIS. GBL provides an additional year-round incubation presence,

on-site networking and consultation, and access incubator management experience gained over 12 years of successful operation in Stockholm.

The involvement of ThoughtWorks for industry-level software training and expert technical coaching is recent but also very promising.

Local and international contacts have also been invaluable in building up a pool of business mentors, guest speakers, review board panelists, sales leads and investors for start-ups, potential programme partners and kindred spirits.

9.7 Respondent 7

Paediatrician, Mulago Hospital; Mulago Hospital Sickle Cell Clinic Database (MUSCD)

9.7.1 Description of innovation

Sickle cell anaemia is a neglected tropical disease affecting about 2% of people born in endemic malaria zones. It is a congenital and chronic disease whose sufferers extremely painful episodes that interfere with school and work, lameness and stroke. MUSCD is an electronic patient records database developed during 2010-2013 for the paediatric sickle cell anaemia clinic of Mulago Hospital. It contains records of patient biodata, contacts, symptoms, diagnoses, clinic visits, treatments, hospital admissions and outcomes. Users of the database are doctors and clinical officers, clinic receptionists and data managers. By systematising the patient records in electronic form, MUSCD enables comparison of treatment protocols and outcomes for different patients, monthly reporting off the clinic's activities, and has increased the clinic's efficiency, allowing it to handle a higher case load.

9.7.2 Potential impact

1. Patients – better access to care due to more efficient clinic operations; more uniform standard of care. Initially Mulago patients; eventually patients in all regions of Uganda (there is no Ugandan SCD clinic outside Mulago Hospital).
2. Physicians – less time spent reviewing patient history and entering visit data
3. Receptionist and medical officers – improved job skills: experience with computer systems, data entry, filing and clinic workflow
4. Clinic Management – ability to attract researchers, research projects and associated funding; ability to lobby for increased support to the clinic using quantitative volume and impact reports.
5. Researchers – ability to carry out retrospective and prospective studies, facilitating their academic career development

9.7.3 Progress

1. Receptionists viewed the system as increasing their workload, hence reducing the time they could disappear to other jobs.
2. Doctors were initially reluctant to use the system until they discovered it allowed them to see patients more quickly. The doctors and receptionists are mainly indifferent to the benefits the system provides to patients.

9.7.4 Resources

1. Private donations for software development, office supplies and the salary of the data manager.
2. Official support from the titular head of the clinic and the Head of Paediatrics
3. Other private donations of computers, furniture, paint and toys to the clinic, by sympathetic local donors who became aware of the improved clinic operations due to the database.

9.7.5 Obstacles

1. Slow software development: The initial Ugandan developers came as recommended professionals but were incompetent. For example, they were unable (or unwilling) to program birth dates in which only the month and year are known. Corrected bugs invariably reappeared in the following software version and had to be fixed afresh. Development of 85% of the current software had to be outsourced to Canada.
2. Lack of organizational support from Mulago Hospital management. With few exceptions, full-time salaried doctors show up for a few hours one or two mornings a week before vanishing to workshops (where they are fed and paid travel allowance) or to their own private clinics (where they refer Mulago patients for consultations and unnecessary lab tests). Most of the other clinic staff follow this example and view reception, filing, pharmacy or nursing work as an imposition on their liberty. This culture is slowly changing, since it needs to be led from the top (i.e. by doctors) and academic turnover is low.
3. Prevailing culture of health care. Medical records are seen as unimportant, since for most diseases such as malaria, the patient history does not matter. So files are disorganised, incomplete and often contain duplicates. But for chronic conditions like sickle cell anaemia (or AIDS), they are vital for proper treatment. And of course they are vital for any research.

9.7.6 Useful support

1. Moral and written support from the Head of the Department of Paediatrics, and from the founder of the sickle cell clinic. These two doctors want better care for the patients, recognition for sickle cell anaemia as a neglected tropical disease, and wish to be able to welcome more clinical research projects to the department.
2. House officers: they are interested in adding to the patient data and using it in their academic research projects. Before the database, it was impossible to do research on this group of patients. Now academic researchers from inside and outside Uganda are becoming interested.
3. Computer and system support: the computing graduate who started as computer technician and data entrant has grown into a dedicated quality manager, software tester and enhancer (many new reports, for example) and knowledgeable resource for clinical workflow and even basic medical information.
4. Local individuals and companies who donated furniture, computers and network equipment after becoming aware of the clinic and the new database.
5. Ministry of Health: Some officials expressed personal interest in seeing the database used to improve standards of care for SCD patients, and gave clear conditions for expanding beyond Mulago.

9.8 Respondent 8

Launch Fund Manager, Mara Launchpad Uganda

9.8.1 Background

Mara Launchpad is a mentorship for profit foundation intended to foster growing businesses all over Uganda. It took off on the 2nd of January 2012 and since then has been providing a variety of services to the growing number of entrepreneurs to increase their integrity, repute and productivity as promising businesses. It recruits and attracts innovative minds from all over the country especially from the country's capital Kampala.

Mara Launchpad was formed under a partnership between Angels Finance Corporation and Mara Foundation these also have stake in a diversity of businesses.

Mara Launchpad offers a variety of services to entrepreneurs of all walks of life and any innovative ideas. The Launch Pad has an innovations centre where business incubation is done.

A special pool of funds known as the Mara Launchfund offers amounts from between 5,000,000

UGX (1953 USD) or less up to 10,000,000 UGX (3907 USD) in return for up to 49% stake in a company. This attracts numerous applications which are screened by the fund management team and the viable businesses are funded.

It also has a mentorship programme where Mentors meet with mentees and are attached to them for 6 months. The programme is currently in its 3rd cycle of mentorship.

9.8.2 Innovators

The selection criteria for individuals (mentees) is not according to any organisational biases, but on the foundation that they are innovative, ready to expand on personal knowledge, work with mentors, team work with fellow members and have a yearning for entrepreneurial growth. The Launchpad through mentorship goes against the traditional teacher-students curriculum and creates one on one interaction between mentor and mentee thus ensuring quicker progress.

The Launch fund on the other hand receives numerous applications from a variety of businesses but these are screened and studied for over 2 months before a commitment of funds if any is made. Most applicants are agricultural in nature, which is also a high risk industry to fund.

Usually the mentees are creative but lack financial, marketing and business skills.

9.8.3 Stages of progress

In July 2012 Mara Launchpad expanded its diversity of services widening its coverage to early-stage innovators who are as low as concept level to later-stage innovators that have carried out extensive trials with end users in numerous ventures.

The mentorship programme will take in incubates at a concept stage while the Launchpad will ideally look for a prototype and launch Fund more advanced incubatees.

Success stories include a large scale Mushroom grower and a Traditional stove cube lighter which is made from grass and helps in the lighting of the traditional Ugandan charcoal stove, both ideas were funded by the Launch Fund and the products are on the market.

9.8.4 Input in concept formation

Mara Launchpad does not directly suggest ideas to groups. Concepts are either propagated as a group or individually developed. Mara Launchpad however encourages the utilization of like-minded individuals and makes an effort to merge sole entrepreneurs into factions, for the numerous contributions group work creates.

These groups are then linked to both in-house and out-house mentors in the related fields to help these mentees come up with more refined ideas and hence ease regarding commercialization. Individuals are encouraged to participate in the Launch pads annual exhibition which attracts all audiences from students to well established corporations which will stir creativity.

The structural setup at Mara Lauchpad allows numerous interactions between all entrepreneurs in all fields as it is open floor office-type setting. As well to further boost interaction between these various entrepreneurs, the Launchpad holds weekly and monthly meetings to address challenges and achievements of the numerous groups and this creates awareness of general progress within groups and creates ground for scrutiny and positive feedback from peers. The launchpad as well holds events such as the Exhibition held on the 22nd June 2013 which was open to public participation and offered registration to all at its website www.mara-launchpad.org.

9.8.5 Input in implementation

Mara Launchpad links the teams with the diverse entrepreneurial minds with diverse knowledgeable mentors available to it through the 16 year old multi-sector conglomerate Mara group www.business.mara.com. These mentors give encouragement, lessons from experience, and other forms of advice to groom enthusiastic entrepreneurial minds at no cost.

The Mara Launch Pad organises events at which the Mentees are given 4 minutes to pitch their ideas and then Mentors pick a mentee they feel best suited to work with. These relationships ideally go on for 6 months and are supervised by the Launch pad to see that the mentee is in touch with the mentor and is getting the necessary assistance the group requires

9.8.6 Obstacles

Many of the ideas and entrepreneurs businesses are still tied down at prototype stages due to the failure to penetrate the existing market with even the preliminary trials with end users still being elusive or in case of some lack of 'muscle power' to get a product sold in a supermarket or hotel.

Many of the applicants to the Mara Launchfund are still not able to write up business plans. This causes many applications to be turned down. The duration of the fund approval seems to be a tedious process as one must first apply online, write a business plan and wait for a two month period to have their plan either approved or rejected. This is seen as an obstacle and a discouragement to many.

Mara Launchpad is a for-profit organization and thus places charges upon those that want to access its facilities. This limits access to facilities such as the innovation centre, networking events, office space and conference facilities to individuals that can afford the fee of amounts between 75,000 UGX (29 USD) to 300,000 UGX (117USD) per month.

Mentors are usually high level executives in different companies and are therefore unable in some circumstances to meet their mentees due to their busy schedules or they are unable to make it to events and meetings for the lack of time and hectic schedules.

9.8.7 Useful support

The Launchfund has a limited amount of money to be given to specific businesses so some donor input in the form of finances could be of a great advantage and broaden the chances for entrepreneurs with promising businesses to receive funding. For example the Mushroom farmer needed money for machinery and upgrade of his premises which he did not easily have access to due to a lack of immediate financing. Other start ups are unable to meet rent after 3 months at Mara Launchpad.

The formation of study booths/ conferences that offer sector specific training to cover areas such as basic business administration in areas that include budgeting, business management, financial forecasting and accounting practices could help these businesses progress much faster.

Use of case studies from former successful members of the Launchpad such as the successful mushroom business, Media256, grass fuel; would be of great use and inspiration to the upcoming entrepreneurs within the Mara Launchpad incubator as mentees seem to lack or not get enough exposure to success stories.

9.9 Respondent 9

Former Manager of the National Software Incubation Centre, Makerere University

9.9.1 Background

From an academic background in the field of software architecture, the Respondent became increasingly involved in technology business in Uganda (for instance founding and running the business Decimalworks). He was the head of the Software Incubation Center from 2010-2011, and remains a member of faculty at the College of Computing and Information Sciences.

The mentors used in the Software Incubation Center during his management were from different backgrounds. External collaborators were brought in from the local business and technology community on a need-specific basis to provide technical oversight, and would be be assigned depending on the project. Another model for mentorship was that companies in Kampala would provide staff to be released for a certain number of hours per week on an employer-equivalence basis.

The center was set up to recruit computing students and graduates with novel business ideas, to support them to develop and commercialize these ideas. After being admitted to the center different phases of business development would be tied to stipend payment.

9.9.2 Innovators

Applications to the center would be made by teams of four or five. The ability range of the team members would vary within the groups. In a team of five, one or two might be from the upper

centiles in terms of their academic record and with strong practical skills. The others might be from middling or low levels of technical ability, not making much contribution to the development of the project, i.e. "hangers on".

For the bright members of each group, software development skills were often quite good. However entrepreneurship skills, such as the ability to identify opportunities and formulate strategy, were generally lacking. The concept of innovation in general seemed to be vague to them. Another issue was of students/graduates lacking confidence in their ability to form a successful business around a technological innovation.

9.9.3 Stages of progress

Of around a hundred total projects run in the center, almost all reached a prototype stage but no further. Only two projects reached a stage at which they were looking commercially viable. One was a project to do with booking tickets by phone, e.g. for bus companies. This team were able to find clients and raise funding on their own initiative. Another team which reached a similar stage worked on the use of Bluetooth for shops and restaurants to do location-specific marketing to smartphone users.

9.9.4 Input in concept formation

Teams would generally form their own concepts, as the concept was required in order to be admitted to the center.

9.9.5 Input in implementation

The amount of input during the implementation stages would vary by project. There would always be guidance at the design stage, concerning the architecture, scope and functionality of the project. Meetings with supervisors would usually take place twice a week for a duration of two hours. As well as advice at a technical level, supervisors would provide advice on strategy, and contacts with potential clients.

9.9.6 Obstacles

A central difficulty was that funding was spread thinly between many groups. The stipend being offered was relatively low, about $100 per month. The reasoning behind this low payment was that innovators would finish the program owning their own business and all intellectual property, and therefore the stipend should cover living costs only in order that they had an incentive to roll out their ideas and profit from them. However, this did not seem to set up the appropriate incentives as was initially hoped. Those enrolled in the center would be actively looking for jobs, and would drop out upon receiving a more lucrative offer. They would often view their position in the center as a placeholder, something to occupy them and make a little income from while looking for a job.

Even where the team members did have the motivation to take a financial hit in order to pursue

their innovation, they had a difficult time explaining the program to their families (on whom they still had some financial reliance). Family members would expect graduates to find a job as soon as possible, and would regard the Software Incubation Center as a continuation of studentship, since it brought in little income and was part of the university. Families would therefore not be encouraging on the whole.

The costs to individuals to pursue their projects also ended up being quite high. For example transport, or company registration costs, or the organization of demonstrations, or meetings with potential clients, or early-stage marketing, could easily cost more than the funding they received from the center.

The relationship between the supervisors and the project teams was at times difficult to manage. Part of the motivation for the supervisors would that would be that they would have some ownership in the resulting company, or some kind of profit-sharing. Because the supervisor would be from a senior, experienced position, they would expect to have managerial influence. The student teams on the other hand could feel that the supervisor had been imposed on them. Whereas the teams themselves have formed organically, the supervisor had been assigned externally—a forced partnership.

Intellectual property was never an issue, although the Respondent felt that it might be a related problem had projects become commercially successful. The companies which provided mentors possibly viewed the involvement with the center as a source of free research and development. Another future problem might have been a team claiming IP for an idea and then failing to implement it, thus locking up the opportunity for future teams.

The motivation of students and graduates was often low; often they did not seem to really believe they could produce successful companies, and their involvement was simply a way to receive a stipend and stay occupied while looking for a job. People would tend to drop out at the first opportunity of a higher salary. Those recruited to the center were expected to work Monday to Friday, 8 AM to 5 PM, though this was impossible to enforce in practice.

9.9.7 Useful support

Paying a higher stipend would get better results. The Respondent estimated that the amount of money needed to give a graduate enough incentive to work on the project should be at least 50% of what they would receive as a starting salary in the IT department of a telecoms company or bank. The way the money is paid could also be improved. If a certain amount is given per team, rather than per individual, there would be an incentive for teams to filter out their inactive members. Another way of solving the "dead weight" problem could be to ask individuals rather than groups to apply, after some screening to see whether they have the right attitude and skills. Teams could then be formed as these individuals get to know each other.

Training in entrepreneurship skills would be useful in order to give innovators the right attitude and expectations. This is still a new paradigm to Makerere graduates.

The Respondent also recommended the creation of conducive social spaces, for innovators to socialize and exchange ideas. By giving people extra reasons to physically spend time in the center, their attendance could be improved and dropout rates reduced.

9.10 Respondent 10

Manufacturer and repairer of battery charging systems, welding machines and power invertors

9.10.1 Background

The Respondent specialized in two-phase electrical business after completing studies in a technical school. He worked for several people and companies dealing in house installations, repair of electrical motors, power regulators and large scale industries making new installations. He gained interest in entrepreneurship when he met an army veteran that was an expert in power installations whose business had gained him clients across the country. After 5 years as a contract worker the Respondent decided to setup a workshop of his own using the capital he had saved from his previous earnings. The start was difficult due to a small customer base. He used contacts he had obtained from previous works to expand his new business. A good reputation gained from previous works was also instrumental in getting him customers through referrals.

9.10.2 Potential impact

Consumers benefit from cheaper and more reliable equipment, tailored to Ugandan operating conditions.

Opportunities ahead are expected in solar power systems and rural areas that need charging systems. The market is steadily growing since they make devices that serve a market segment that experiences failures from imported products. They make wielding machines that can be used for 24hrs non-stop; the Respondent claims the imported alternatives are more expensive and can only work for 8 hours at a time.

9.10.3 Progress

During the past 6 years, he has manufactured hundreds of charging systems, wielding machines, step-up and step-down transformers and power invertors. He is also anticipating manufacture of specialized power control system to be used in factories to protect against electrical hazards. He observes that those available on the market have several shortcomings that have been the cause for many loses due to power problems. Sales for the devices have been improving though the growth has not been as good as desired and he look forward to more growth.

Their products are mostly bought by companies or technical schools starting up new workshops. There has been an effort by some technical schools to give each student a machine

on hire-purchase at the time of school registration. Such schools and workshops have given them big businesses. The schemes have also been great for students since they leave school with tools of trade—this is indeed helpful since most families in Uganda tend to leave their children on their own as soon as they finish academic programs. However, such schemes have been few in Uganda. Such schools / workshops are commonly from South Sudan that give students such loan facilities.

9.10.4 User reaction

Katamba states that his customers like his machines and others made by local engineers. The machines manufactured locally are liked because of their low prices and durability. Their machines are used in workshops with very heavy workloads that also experience poor regulated power supplies. He indicates that imported machines have fancy things such as digital displays and beautiful casings, but in many cases fail under poor power supplies and above average working hours. The welding machines they make are trusted and tailored to the overloading conditions in Uganda. The prices for their products are 25% cheaper than the imported brands. Table 9.1↓ shows key products and prices.

Item	Price (USD)
Battery chargers	200
Welding machines	240
Step-down transformers	12
Step-up transformers	24
Invertors	60-240

Table 9.1 Typical prices for locally constructed electrical equipment.

9.10.5 Obstacles

The main challenge to their business is marketing. He says that in many cases funds for radio adverting are get finished before their product has achieved market awareness. Advertising is very expensive for them, so they rely most on word of mouth and referrals from past customers and friends. Innovation is expensive for them in terms of time invested. Sometimes they feel that the returns on time invested to create a product are small. In many cases the returns take a long time, yet they have to sustain their families and livelihood.

Katamba worries that most innovators hardly collaborate among themselves for knowledge sharing—as a result there is a lot of reinvention and duplication of effort. The problems result from intellectual property protection. He sometimes holds onto key information to ensure that

the technical teams he supports return to him for further consultations. He stated that sometimes this is necessary to ensure that someone does not simply runoff with his skill to make money while himself he remains in the oblivion of poverty.

9.10.6 Useful support

Experience of World Bank program for skills development

Five years ago, the Respondent was invited to join an association known as Katwe Small Scale Industries Development Association (KASSIDA) that was funded by the World Bank with a purpose of equipping them with technical skills and market expansion for their products. They joined the group and many of them obtained membership cards to the association.

The patrons to this association were powerful figures from government and the army. The association architects mostly organized workshops in expensive hotels where the young men and women involved in small-scale industries were invited to attend workshops. The Respondent states that he had little to learn from textbook content that was not applicable to the technical and business aspects of their work.

He wishes that the money used to buy them soft drinks and samosas could have helped them better with advertising of their products. The association also acquired land in an up-scale residential area which is 15km from the business center in which they are currently operating. This to them is again a waste of money since most of the association members would not be will to migrate to place that is distant from their customers and suppliers. The piece of land that was bought is apparently neighboring lakeside beaches and hotels.

The Respondent says that most innovators have lost trust in organizations / individuals that come to them with promises of funding. He felt that in many cases 'patrons' exploit innovators and only use them to collect funds without tangible output for the innovators.

9.11 Respondent 11

Mechanical Engineer and Metal Fabricator

9.11.1 Background

Kato and his three colleagues have a business for mechanical engineering works and fabrication. The person in the team with the highest level of formal education is ordinary level certificate while the rest have most trained on the job for all their skills. Their workshop is located in Kisenyi-Nakivubo near the Kisenyi bus terminal in Kampala.

The workers in this business learned through trial and error. They were previously involved in welding works at a young age and didn't make it far with formal education. They had a strong desire to learn metal fabrications and they stayed at it from when they dropped out of school.

At this skill level they claim ability to mold anything and fabricate any machinery that is presented to them so long as necessary materials are availed. Interesting they're also good at finding alternative workarounds in order to have a working system.

9.11.2 Description of innovations

Their workshop is in an area that makes sauce pans, frying pans, spoons, forks, cooking stoves, animal feeders and many other items. An example product they fabricate is a drum-like machine measuring about 1.3m in height and 1m in diameter, used for mixing wheat-flour to make bread dough. The machine is fabricated from strong steel plates that makeup the saucer and protection cage for moving components. The saucer is fitted on bearings that also get inter-connected for movement to a pulley supported by a car differential. The car differential is used for longevity since it's manufactured to withstand heavy automobile workloads. These car-differentials are obtained from cars that have been developed irreparable mechanical failures. The type of differential to be used depends on the workload anticipated for the machine. The same workshop also hosts a large lathe machine which is used for holding, cutting and molding steel bars, car engines and automobile parts such as differentials. The workshop has two types of business that are operated in slightly different approaches: the lathe-based business and the fabrications business.

Devices made on the lathe machine are mostly short-term or one-off repairs and molding tasks. The workshop for examples charges fees for creating grooves into steel bars. Sometimes, they have to press steel into unique shapes requested by customers or to cut steel bars into smaller sizes. The Lathe machine is also used for sophisticated repairs to car parts such as driving shafts and engine-boxes.

This workshop seems to enjoy a large customer base because of the scarcity of Lathe machines in the business area. The latch machine is very expensive and could have cost them USD 20,000$. An internet search however revealed that these machines are priced between USD 3000 and 7000$ by sellers in India and US. It is also possible that they could have paid much higher than average market prices because they don't have access to the internet or they didn't have means to pay online. This business area has only two machines of this type, which seems to suggest that the owners enjoy a business monopoly. The machines that they use in their business have a low power consumption which allows them to save money on operational costs.

The presence of thousands of second-hand cars in Kampala means business for their workshop. Their business makes daily repairs to car shafts whose alignment needs adjustment or whose ball-bearings need replacement. The Lathe business makes a contribution to the longevity of vehicles in Kampala. The housing construction and demand for automobiles in the country also provide a good source of revenue for their business.

According to the proprietors, the business has good returns even though the initial investment is high. Their figure for initial investment for the lathe machine is about USD 20000$. Their

services for equipment repairs and metal fabrications range between range between USD 20$ and USD 200$. They stated that on busy business day their team of three can easily earn USD 400$ in revenue.

This workshop in Nakivubo-Kisenyi also makes mixers for making wheat dough and maize milling machines. The business for making these machines started as result of buyers for imported machines wanted alternatives that could handle the heavy workload involved in their businesses. Several workshops in Kisenyi have developed skills to manufacture high-quality and durable machines to meet Ugandan industrial needs. They supply their machines across the country for some of the busiest bakeries and milling centers.

9.11.3 Stage of progress

The workshop provides a livelihood for the Respondent and his colleagues. The wheat mixers, for example, sell at an average of 4M UGX (1600 USD). These machines are created on order due to the high-capital investment needed to make one. The inventors fear the risk of their cash being help-up by a machine that may not be sold in the near future. It takes them about 5 days to have the machine completed. The business is good enough for meeting their needs.

Products are fabricated on order. The reason for this is avoid investing money in a product that will stay for long in the workshop without being bought. There is a growing trust for the locally made machines since they're more durable than imported types. The increased demand for maize flour in neighboring Democratic Republic of Congo and South Sudan has created a huge market for their products.

9.11.4 Obstacles

The main challenge to their business is spare parts for their machine machines. They indicated that the lathe machine for example is old and therefore spare parts are very difficult to find and when found the prices are usually high. Spare parts are sometimes difficult to obtain. The high price of spare parts means that customers have to pay more for the final products and thus reduce on their sale volumes.

The work is labor intensive, but the workers to help in the workload are few due to a lack of skills. This lack of skill is attributed to impatience of new recruits that leave workshops for quick gains before acquiring strong skills. The experienced workers also find a challenge of resources to be used in training new recruits. Most materials available to them are obtained for final products to be delivered to customers. This therefore leaves little room for novices to train and practice newly acquired skills.

9.12 Respondent 12

Head of Agricultural Extension and Innovations Department, School of Agricultural

Sciences, Makerere University

9.12.1 Background

The Department of Agricultural Extension and Innovations (DAEI) aims at facilitating the communication between innovative products producing groups in Agriculture with the target users who could be farmers, agribusiness as well as related NGOs.

The communication takes an iterative nature with DAEI actively sourcing needs of farmers and agribusinesses on one hand and feeding this information to groups that can innovative appropriate solutions; which solutions are provided to the farmers who in turn provide feedback. This process is repeated several times till an appropriate agreeable solution is found.

9.12.2 Innovators

Because of its communicative and bridging role, the department is involved in a broad range of agricultural sectors. The Respondent highlighted two important sectors; (1) innovations centered round the creation of new crop varieties which could be high yield seeds, resistant varieties, faster growing and maturity breeds, etc, and (2) innovations centered around reduction of post-harvest losses and specifically innovations from the food technology and incubation center of Makerere University that produces all sorts of products for example yoghurt from soya bean, all kinds of juices, wine, and many more products.

The food technology and incubation center also incubates small companies centered around these innovations.

9.12.3 Stages of progress

According to the Respondent, the department and by extension the college has come up with many innovations, which have, all reached the prototype stage; all products in the food technology and incubation technology center (http://ftbic.mak.ac.ug/) were highlighted as examples of these innovations. The center also incubates some small companies that try to take these products from prototype stage to market.

Because of the nature of the products for example juices from several fruits, yoghurt, and several other edibles, taking these products to market does not tend to require further processing from the prototype stage. The issues seemed to be around packaging and maintaining a sustainable supply of raw materials and products. This is because the raw materials are obtained from a variety of farmers; there are no big farmers who can consistently produce the raw materials for a lot of these products.

9.12.4 Input in concept formation

DAEI in part is actively involved in sourcing potential problems that potential target groups for innovative products are facing. The department ever so often visits farmers associations and agribusinesses to understand the actual needs of farmers for example as well as understand any

prevalent problems which could be area specific (geographical) or commodity specific (e.g. problems affecting cassava crops). They also actively use results from crop surveillance done by several national agencies e.g. NaCRRI.

These challenges and prevalent problems are passed on to various teams for example those in crop science or post harvest food processing and innovative solutions to these problems are sought.

9.12.5 Input in implementation

The Department is also involved in dissemination of successful research outputs, as well as training potential end-users for example on advantages of improved varieties of crops. It does not however engage in the actual innovative work required to come out with a product.

9.12.6 Obstacles

The major obstacle impeding these innovative technologies from going to scale was highlighted as lack of support to commercialize the products. The Respondent cited the many products from the food technology center that have been well received by end-users but for a particular set of reasons have not gone to market. Some of the reasons why this is so are; the private sector is not willing to invest in taking such products to market because of the huge costs involved. The Respondent cited Mukwano Industries, a company that deals in household products, as an example of a company that has had not only to build a factory to process sun flower cooking oils, but has also had to import the seeds used to plant the sun flower, as well as give loans to farmers and collect produce from them all in a bid to ensure sustainability. These high costs scare off potential private sector investors from these kinds of investments.

Paul also cited the poor quality of prototypes as an obstacle to taking these products to market. The quality tends to be below the quality of imported goods for example in the packaging and processing and as such end users tend to shun these products. A related problem is a poor attitude of Ugandans towards local products. The general preference to imported goods was cited as a key obstacle.

The lack of awareness of the farmers of improved seeds for example was also cited as an obstacle. Also improved seeds tend to be more expensive than the de facto seeds, which results in farmers selecting the cheaper weaker varieties. An example Paul offered was that farmers were more willing to pay for improved imported seeds from Kenya than get the locally improved seeds because of cost.

Big international corporations for example Coca Cola, Britannia also stifle local companies when it comes to selling similar goods. Coca Cola can import cheap concentrates and make packed juice at a price cheaper than what a local company would expend to produce a similar local product.

9.12.7 Useful support

Government should introduce suitable policies that protect local products, a formula, which has worked in other countries. With suitable policies for example tax exemptions and subsidies, the Respondent felt local innovations in agriculture could be boosted.

There is little support from Makerere University outside provision of office space. The department and most innovative teams have had to source for funds through grants from donors. With more commitment and support from the University, the innovation space would go a long way in this sector.

9.13 Respondent 13

Manager of Food Science and Technology Business Incubation Center (FTBIC), Makerere University

9.13.1 Background

The incubation center was started to in 2010 as an engine for job creation and skills development in the development of new food value addition businesses based on research conducted at Makerere University. The center has been supported since 2010 through a Government of Uganda Presidential initiative on the basis of value addition and job creation. The center has procured equipment for meat, dairy and food processing and analytical equipment for assessing quality of food products.

The center offers a platform for students to venture into entrepreneurship. The incubatees who are mostly fresh graduates are offered access to processing facilities and provided with technical support to boost their capacity in production, marketing and business management. Some of the developed products are sold in leading retail outlets in the country, contributing to import substitution. The incubation center also has a retail outlet at the School building.

The center also contributes to the overall food industry development through provision of technical support to food processing SMEs and conducting hands-on training for prospective entrepreneurs. The center aims to create 20 new agro-processing businesses and 500 jobs annually. FTBIC is still training experts in the food processing sector with a strong hope of having a forward and backward link with the agricultural sector. The people in the agro-processing will influence the quality of produce that comes from farmers in return for premium prices.

The center also recently acquired a mobile fruit and vegetable processing plant to facilitate processing of fruits and vegetables from production areas. The center is focused on developing world class products from locally abundant raw materials. FTBIC also houses the only citrus extractor in the country. Such facilities are giving the school good business revenues. FTBIC

wants to encourage farmers to form cooperatives to own such machineries which would be managed by experts trained at the School of Food sciences.

The teams and individuals mentored are sought from applicants that have exhibited interest in entrepreneurship. Many of these individuals are driven by a desire to run their own businesses and creation of a product that fascinates them.

9.13.2 Stages of progress

Almost all the products that have been brought the incubation center have been developed to final completion. Several products have been developed at the center and many are available in outlets such as Capital shoppers, Uchumi supermarket and Tuskys. Products such as tea spices, fresh juices, wines, processed meat, dairy products and cereals have been developed into registered business enterprises.

FTBIC is actively innovating to create value addition in the food processing sector. FTBIC recently designed specification for a mobile fruit and vegetable plant which was used to process 100,000 metric-tones of mango juice. The supply of mangos was far above the processing capacity of the mobile unit. It is estimate that the fruits processed in Yumbe didn't account for 2% of the total production yield during a harvest. The team realized that they can do a lot more processing if the market for their juice is also expanded.

9.13.3 Input in concept formation

The vetting process is rigorously carried out by domain experts that also commit time and resources to enable realization of the final product. In many cases innovators come with ideas on which they're given technical help by experienced mentors to create a final product.

9.13.4 Input in implementation

In many cases the incubatees rely on experienced technical teams that understand the manufacturing process at the start of the projects. A detailed step-by-step guidance is necessary at the start.

9.13.5 Resources

Government of Uganda supported establishment of a laboratory and manufacturing equipment. There is need for funding business development so that the manufactured products reach targeted consumers.

9.13.6 Obstacles

There is little support from government institutions after a product has been created. The Uganda Investment Authority and the Ministry of Trade and Cooperatives have not done enough to support business development for products that have been created.

The incubatees have a rough landing since they cannot access business loans using the ideas or

potential of pilot products. Some of the products such as soft drinks have to compete directly with large companies with large advertising budgets such as Coca-cola, Pepsi and Riham. Innovators use the incubation center equipment when they're still enrolled. It has been a big challenge for some of them to continue manufacturing their products after graduating. Capitalization is a huge challenge for entrepreneur that wishes to continue making high-quality products.

Intellectual protection is another challenge. The innovator has to protect their skills since the manufacturing process uses generic technologies and techniques.

9.14 Respondent 14

Founders and Creators of The QR Code Reader/Scanner (Software Business Incubation Programme)

9.14.1 Description of Innovation

The Quick Response Code abbreviated to QR Code is an optically machine readable two-dimensional label that is attached to an item to record and store information related to that item.

The QR code consists of black squares known as modules that are arranged in a square grid by a code generator and placed on a white background next to the product's label strip. In layman's terms, a QR code is a bar code, in that it can be scanned with a code reading device and it will present some information based upon what is held within the code. This can be cross-referenced with an application specific database, with many use cases in education, business licensing, medical records, and so on.

The QR Code Scanner was developed by the Respondent s in an application development project as students of software engineering in their third year. The application runs off mobile devices such as cell phones, tablets and a variety code scanning equipment. This group of individuals handle all the coding, software, product development and customization depending on the potential client's demands.

9.14.2 Potential Impact

The impact of the QR Code Reader is extensive in a work environment as QR codes can be used to ease access to a variety of information linked functions in any day to day activities. The QR codes can carry information within them that can link an individual to websites, map coordinates, staff credit information, company profiles, student exam results, phone numbers, YouTube videos etc. The benefit being saving time and reduce bureaucracy in any environment which is a problem in many corporations.

9.14.3 Progress

The application has been deployed on a small scale, and is functional and customizable to any users needs. The QR Code Scanner goes for a unit price of 10,000UGX (3.9 USD) per unit and comes with a variety of after sale services. The team that runs the application has only managed to secure a small company as clients incorporating the QR code into identity cards. Plans to further develop the application and extensive marketing are in the pipeline.

9.14.4 User Reaction

The initial reaction from all previously approached parties is extremely positive and demonstrations about the effectiveness of this product have been successful. Users agree to the diverse solutions this product could provide to their organizational flows and how it would ease difficulties such as prolonged bureaucratic procedures.

The relevance of this application to the multitude of analogue based enterprises and the slow migration of many businesses to digital use still slows the potential of this products use.

9.14.5 Resources Available

Further development of the QR Code Scanner is under way with the team, other affiliates and mentors within and outside the Makerere University. They were with the Software Business Incubation Programme for a year which helped them develop from an idea to a viable business. The group meets on a weekly to monthly basis with many ideas being brainstormed amongst them. With this, they come up with lists of potential clients and part of the team moves to arrange one on one meeting with the representatives of the companies they have listed.

They continue to look online for new innovations and talk to mentors in SBI when they feel it is necessary.

9.14.6 Obstacles

Many positive responses have been received by the team after their demonstrations of this products efficiency. However, the technological gap between the operations of the business presented to, and the use of this type of technology has to be covered before this product can move to brunt their efficacy in the day to day running of these enterprises.

The Respondent s mentioned that the QR team faced a lack of finances to purchase testing equipment in the form of scanners, mobile phones and other tools need to customize, test and present the application which their only resource, Makerere University, was unable to supply when urgently needed.

The team struggles with motivation, as some members went on to get other forms of employment and reluctance of the above to attend meetings due to busy work schedules has led to demoralization among the still unemployed members of this company.

The lack of an effective legal system to enforce and fight copyright infringement leaves this application exposed to pilfering. The high cost of the copyrighting ideas is still a huge expense on the side of the growing company thus they look to forgo the process hence exposing their product. They recently missed out on a contract with KCCA to provide the QR code for taxi stickers, believing their idea was taken up by internal competitors after several presentations to KCCA.

The QR team struggled with the issue of bureaucracy as it was difficult for these novice entrepreneurs to access high level influential clients and those in management positions. Most of the individuals presented to were unable to steer these big corporations in the favor of the QR reader team.

Related to the above some of the clients still had a problem seeing that the company was young and went ahead to question their reliability as they were afraid of being defrauded by the teams representatives who were taken at face value as too young to execute the tasks the companies would be placing in their hands.

9.14.7 Useful Support

The Respondent s suggested that encouragement in form of finances to carry out important purchases, financing large scale marketing trips and other basic demands would greatly boost their company and its need to reach potential clients.

The team went ahead to mention the need for further mentoring in the area of software engineering and development to improve their knowledge and exposure. They as well mentioned a preference in mentoring from companies such as Google Uganda, Nokia, telecom companies and their own professors at Makerere University.

The need for help in their search for market was the most pressing need as it came up numerous times during the interview. They pointed out the need for mentors to connect their young innovative minds with the right potential buyers and giving them a chance to run prototypes in these companies to establish trust and as well be given a chance to prove their worth as individuals and as a group.

9.15 Respondent 15

Business / Systems Analyst, ThoughtWorks Uganda

9.15.1 Background

ThoughtWorks is a software company that has developed several community engagement products to impact social change. ThoughtWorks (TW) aims to encourage disruptive thinking to deliver innovative software products that will revolutionize the industry to create positive change. TW claims to an advanced and successful agile methods of software development and

best practices. Since 1993 ThoughtWorks has grown from a small group of in Chicago to a company spread across 27 offices in eleven countries: Australia, Brazil, Canada, China, Germany, India, Singapore, South Africa, Uganda, the United Kingdom and the United States.

ThoughtWorks has visited Makerere University on several occasions to recruit software developers for their office in Kampala, Uganda. The Kampala office has more than ten Ugandans (most of them graduates from Makerere University) working on several software development projects.

9.15.2 Training programmes

After working with several groups of students, ThoughtWorks realized a need for passing on some of their expert skills to young developers coming out of University. The program was started in June this year (2013) and trained 15 students as a pilot in state-of-the-art approaches to software development. This project was driven by the need to fill skills gap faced by most fresh graduates from University. ThoughtWorks had come to a realization that most fresh graduates were not ready for work on IT industrial projects.

The training was organized as a 3 weeks program to impart industrial level skills to finalist students. The training was conducted by experienced software developers that came from Asia and Europe to train the selected students. All expenses for travel and accommodation were met by ThoughtWorks. The students were also offered follow-up mentorship by the trainers to keep them actively pursuing the skills they had learned and to offer continuous support where difficulties would be experienced or anticipated.

The ThoughtWorks software development training was different from previous trends of boot-camps and hackathon meetings that have been popular in many parts of the world, Uganda inclusive. Raymond and the TW teams realized that such events do not give students or participants new skills. Those events are good for social meetings and sharing of ideas, but are largely insufficient for creating new high impact skills and products.

The Respondent says that most of the skills and approaches used by ThoughtWorks trainers were largely new to the trainees. The training was hands-on and students were given model projects that were used as references cases for their training. Test Driven Development (TDD) took the largest part of the training time. The trainers were interested in seeing students adapt these skills to their own projects.

ThoughtWorks liked the opportunity of offering some of their best practices in software development to finalist students and they look forward to doing the same in the new future. Their objective is not for trainees to create new products or apps, but to have a legion of high-skilled developers contributing to the eco-system of software development, most especially for open-source products. The Respondent thinks that extending the engagement period with trainees is likely to produce better results than the short-term 3 week sessions.

9.15.3 Obstacles

Preparations for training sessions are expensive since they have to pay for travel and accommodation expenses for the trainers.

Trainer reviews showed that 90% of the students did not adapt the new skillsets to their projects. As much as students appreciated the new skills learned, they found that TDD was reducing their productivity time. Raymond associates this judgment by trainees to the short time of exposure to the new approaches. He states that it takes any developer new to TDD and Agile software development techniques a period of hand-holding before they become productive on their own.

9.16 Respondent 16

Manager of Microsoft Innovation Center (MIC), College of Computing and Information Sciences, Makerere University

9.16.1 Background

MIC is one of many worldwide innovation centers set up by Microsoft Corporation. The MIC center is the only Microsoft Innovation center here in Kampala (Uganda) and is housed at the School of Computing & Informatics Technology in Makerere University. It has been in existence for the last 2 years and in total has handled about 20-25 innovative projects.

MIC has three aims; (i) to source for and encourage innovative ideas/concepts from students, (ii) to incubate these ideas by providing infrastructure, software and technical support and (iii) to act as an accelerator for innovative ideas and teams.

9.16.2 Innovators

MIC mainly targets students at different universities and looks out for ideas and teams that could be incubated. It does this by evaluating and identifying innovative final year student projects that could be taken up by the center. It also carries out bootcamps and hackathons from where it fishes students and teams that seem to have good technical skills and innovative ideas.

Each team identified with a good concept is given training and mentorship by the center in varied subjects such as idealization, innovation, entrepreneurship and technical skills (related to Microsoft products). Teams are also linked with professional product teams from Microsoft for additional support and mentoring.

9.16.3 Stages of progress

In the last two years, MIC has evaluated between 60-80 concepts and taken on about 20-25 innovation projects from student teams. Of the 25 or so teams that were taken on by the

center, 6 are presently active and within the center. These have reached prototype stage, and have been entered in to the Global Microsoft Imagine Cup competition that evaluates innovative projects from students around the world. MIC has had two of the projects winning prestigious awards; the WinSenga project and the Code 8 Matibabu project for diagnosing Malaria using a mobile phone. The WinSenga team also won a cash award from Microsoft.

The rest of the 19 teams that were being incubated by MIC either split up and joined regular employment due to pressing day-to-day needs or the moved onto different accelerators e.g. Mara, HiveCoLab.

9.16.4 Input in concept formation

MIC actively sources for innovative concepts from final year students' projects and from head hunting teams and groups from their attendance to MIC organized bootcamps and hackathons. Drake says they take this route because the successful projects they have accelerated; the ideas originated from real problems the students were facing. For example WinSenga was a result of one of the members visiting a hospital and seeing a midwife listening to an expectant mothers belly using a horn-like device, Code 8 project was born out of one of the team members going to hospital several times and having his skin pricked every time to draw blood for laboratory testing.

During MIC organized events including bootcamps, innovation seminars, career guidance sessions, technical trainings, students or teams are encouraged to come up with innovative concepts that could be incubated and accelerated. Some teams after the initial engagement with MIC move onto other startup accelerators for example Mara or HiveCoLab which have a better environment and where there are more available mentors.

9.16.5 Input in implementation

Once promising concepts are presented to MIC and MIC accepts them, they offer the students training in innovation and training on Microsoft tools that could be used to implement the ideas. MIC also links the students with mentors majority of them coming from companies outside the university.

Microsoft also offers competitive funds (YouthSpark) to assist in product development once teams present a working prototype of their system. Microsoft is only interested in product development and not necessarily concept development and research. Microsoft also offers devices (e.g. windows phones, game consoles), development platforms and technical support. These are however restricted to Microsoft products.

9.16.6 Obstacles

MIC lacks sufficient mentors; most mentors are volunteers from different companies outside Makerere University and mostly during the advanced stages of the projects there are clashes between the teams and the mentors because the mentors tend to have individualistic motives,

which may not be compatible with the groups'.

There is lack of funds to support the incubatees and the mentors so more often than not the teams move on to look for gainful employment in regular companies. Even for teams that were initially successful like WinSenga, that obtained funding for product development and enhancement, several of them have had to get jobs and work on the product on a kind of part-time basis.

Drake also felt there is lack of innovation support at the strategic level of the University and the country at large. The fact that Makerere does not budget for innovation was one of the indicators for this. At the national level, the lack of a policy on innovation was also identified as an obstacle. A policy on innovation could ensure that there are certain subsidies or tax reductions or product protection laws that could support innovation.

Drake also cited duplicity of effort by several innovation accelerators, citing a case in point where a particular team was being mentored by two separate accelerators unknowingly. Because accelerators have different entry requirements, Drake identified this as a possible place where they could work together, for example MIC could incubate teams through the concept stage to the prototype level and other accelerators like Mara can take on the teams to development. This will reduce the strain on the innovation centers.

Drake also identified issues such as patenting as possible obstacles.

Another obstacle to innovation in general was that local innovation competitions for example the ACIA annual awards that tend to award innovative prizes to organizations or groups for products that are really not very innovative. Drake identified this as a limiting factor in giving teams the impetus to spend time doing innovation and staying the course.

9.16.7 Useful support

The training of university graduates cannot be over emphasized. It appears graduates lack essential problem-solving skills and have a total lack of knowledge about entrepreneurship and innovation. There is need to strengthen the training at Universities.

Funding innovation centers like MIC to be able to take on mentors and pay teams stipends was also identified as a key enabler if innovation is to be brought to the forefront. Funds are needed also to develop suitable infrastructure to support innovation. Most teams leave MIC because of the poor infrastructure offered by the university.

Getting a champion for a product was also identified as something key. For example the WinSenga team is trying to get the Ministry of Health as a key champion for their product. This is still problematic however because of all the bureaucracy involved.

Government should put in place policies that support innovation. Programs like the Youth Development Fund should be targeting innovation in the youth as a key component of the

program.

9.17 Respondent 17

MSc Student Innovator: Water Level Monitoring System for Valley Dams

9.17.1 Description of innovation

The innovation is a water level monitoring system for valley dams. The system uses a sonar sensor mounted on valley dams to take readings of the water levels at specified times and send out alerts to key stakeholders once the water levels pass certain thresholds. The system is powered by a solar unit mounted on the valley dam that charges an ebox computer that processes the readings from the sensor, an I888 motherboard and a mobile phone that sends out alerts to key stakeholders for example the district water officer.

9.17.2 Potential impact

The main beneficiaries of this system are the local authorities in the area of the valley dams, including the district leaders, the district water officer, the disaster preparedness personnel and the farmers who use these valley dams to obtain water for their crops and animals. A typical use case of the system would be that the local authorities are notified by the system about reducing levels of water in the valley dams and the authorities inform the farmers in advance of the imminent situation and mitigation procedures can be put in place.

9.17.3 Progress

The system was started as a postgraduate final project and was carried through until prototype stage. Minimal testing was carried out at one valley dam. Project was started in 2011 and a prototype was ready by mid 2012. The system is has since stagnated owing to several obstacles.

9.17.4 User reaction

The Respondent indicated that he has had poor reaction from the Government institutions that would be primary users of this system. The public reaction by these institutions however is very positive; several newspapers have run stories of this application with government officials welcoming the idea and stating that they are willing to offer all the support and take it on. However on trying to follow through on some of these promises, the Respondent has found stiff roadblocks with most government officials dismissing the idea entirely.

This kind of negative reaction however seems to be negative in the sense that the institutions are not willing to spend time and money in this endeavor despite thinking it is a brilliant idea that could help local farmers. Basically the reaction is more in the direction of ‘there is bigger fish to fry’.

9.17.5 Resources available

Being a student project, the Respondent had to fund all of the development of the system. A total of about USD 500 was expended on the system to get it to prototype stage. This cost is only for the equipment. Technical support was provided on the project by his supervisor.

9.17.6 Obstacles

The main obstacle identified by the Respondent was that while the government officials seemed to understand the benefit of such a system, they were not willing to give it the requisite support in terms of funds, time, linkages, etc. to get it past the prototype phase. There seems to be an unwillingness of government institutions to take on innovation projects like this possibly because of the risk involved.

After presenting the project for the award of his master's degree, the Respondent has all but shelved the project because of lack of funds to continue the research. Funds would be needed to pay his basic maintenance as well as purchasing better equipment including sensors, motherboards, etc. to take the system to the next level.

A related obstacle is that most innovative projects are usually student projects that are implemented as a requirement for the award of their degree. The lack of mentorship and support to bring the projects up to fruition after their initial purpose is fulfilled (award of degree) is one of the big hindrances of these projects advancing from a prototype phase.

For the Respondent 's project another significant obstacle was the lack of relevant equipment for example the sensor and the motherboard had to be bought online. Any further advancements to this project for example buying profession-grade sensors or investigating other possible leads was hindered by the lack of this equipment. Again mentorship in this area to propose possible alternatives is a key need.

9.17.7 Useful support

The Respondent thought one of the principle support interventions that can really aid innovation was having appropriately skilled mentors to guide young innovators. He thought without proper mentorship he would not have gotten this far. Mentorship for him came in handy in suggestions of what equipment to try in the prototype phases, in the technical implementation of the project and in highlighting the possible directions the project could take.

Funds to support the development, testing and marketing of the innovation was also identified as a critical support factor. Having the right collaborative and partnership frameworks with the telecommunication companies was also identified as a good support strategy. A lot of the innovations in the field of computing tend to rely on the use of the mobile telecommunication network so having these collaborations can go a long way in supporting innovation.

9.18 Respondent 18

Operations and R&D Manager, Mwoto Stoves

9.18.1 Description of innovation

The Mwoto Stove is an improved cooking stove design—specifically, a top-lit updraught gasifier—which was initially developed in the Centre for Research in Energy and Energy Conservation (CREEC), Makerere University. It uses firewood rather than charcoal, makes significantly more efficient use of fuel than traditional stoves, and produces charcoal as a by-product (captured from the carbon normally lost as smoke). It produces no smoke, and cooks food more quickly than is possible with charcoal.

A system for making fuel briquettes from common organic matter is also currently under development by Mwoto Stoves. This system involves chopping and threshing the raw material (e.g. maize husks or chopped grass) and compressing it with a binding agent such as cassava starch to produce solid fuel for the stove which is low cost and environmentally sustainable. Whereas some individuals make such fuel briquettes currently by hand, and commercial systems for briquette manufacture are available (priced on the order of tens of thousands of dollars) they are trying to occupy a middle ground of machinery which can be made by local carpenters and metalworkers.

9.18.2 Potential impact

The main impact is in terms of fuel savings for households. Charcoal is the main fuel for cooking in Uganda, but the supply is not sustainable. Prices have already risen sharply in the last few years, and this will inevitable continue. By reducing dependence on wood fuels, there is also a potential for positive environmental impact.

9.18.3 Progress

The stoves are at the stage of full deployment. In the last year, around 1600 stoves have been sold, at a price of 35,000 UGX (14 USD) per unit, and this is scaling up.

The briquette making system is at a prototype stage. Additionally, plans to produce institutional-sized versions of the stove, to take advantage of opportunities for selling e.g. to schools and hospitals, are at a concept stage.

9.18.4 User reaction

The initial user reaction to demonstrations of the stove has been positive. The fact that the stove costs less to run than traditional alternatives, emits no smoke and can produce charcoal, are strong selling points.

However, the price of the stove is seen as being prohibitively high. For comparison, a traditional clay cooking stove which uses charcoal costs around 5,000 UGX (2 USD). Most potential users

are unwilling to pay the higher price even though the investment would be repaid in a matter of weeks or months due to lower fuel costs. The equipment itself has a simple appearance, which seems to lead to a low perceived value, contributing to a reluctance to pay the asking price.

Of the stoves sold last year, a study that Mwoto Stoves carried out to follow up on some of the sales found that only around 20% of the stoves that were sold were actually being used regularly. The most common reason for the product not be used seems to be the lack of availability of appropriate fuel. However, most customers said they were happy with the stove and that they would recommend it to others, even if they did not regularly use their own.

9.18.5 Resources available

While the development of the stove was being done at CREEC (with which directors of Mwoto Stoves are semi-affiliated), a marketing campaign was carried out to stimulate demand. The background to this was that CREEC trained over a hundred tinsmiths to make the stove, and had planned for them to go into private enterprise selling the stove. In fact, a negligible number of the tinsmiths did make any Mwoto Stoves on their own initiative, seemingly due to their lack of capacity as individuals to find sales, source materials and so on. So, while that strategy was not successful, it provided a starting point for Mwoto Stoves to step in: the first version of the product had been already developed, and some awareness-raising about the product had been done.

CREEC were also able later to arrange an order of 500 stoves, which give Mwoto Stoves some guaranteed demand. With some of their return on investment assured, this made it feasible to invest money in their workshop and further marketing and R&D efforts. This was very significant to the feasibility of the company.

Mwoto Stoves also benefited from other information available online, e.g. open source plans for choppers and threshing machines.

9.18.6 Obstacles

While users like the product, the cost is difficult for them to pay. Even though this investment would be repaid in a matter of months, cash flow of customers is a barrier to adoption. The product also involves a change in users' fuel-buying behavior, which has proven to be an obstacle. The stove innovation in isolation therefore seems to be one element of a solution to users' fuel problems, but a more end-to-end solution could be necessary for more widespread adoption to happen.

Problems were encountered in partnering with organizations that could provide demand, in that many individuals have the opportunity to obstruct a deal until they receive some benefit. A partnership is being pursued with a large sugar plantation of over 8000 workers, in which stoves are to be given to workers up front through their welfare department, and paid off gradually through salary deductions. Despite this arrangement having management support at the top

level, commission agreements had to be worked out at several lower levels in order to see any progress.

Related to this, it is difficult for a small group of entrepreneurs to access potential institutional clients at a sufficiently high management level, particularly when those individuals are technology rather than business focused. The arrangement with the sugar plantation was in fact initiated by a (male, ex-pat, and well-connected) third party, although once an initial meeting had been brokered the Mwoto Stoves team were able to pursue the agreement on their own.

Another difficulty with respect to fuel production is that direct donor support has been given to competitors, for example in the form of industrial-scale briquette making machines. Competitors which have been provided with such equipment or subsidization can undercut potential innovators developing their own technology and who do not have access to such support.

9.18.7 Useful support

The Respondent suggested that help in finding market demand would be a useful type of support in general. This could be in the form of helping to connect innovators with potential buyers, or of directly placing orders. By reducing the risk of the venture in this way, some of the substantial difficulties of innovating in Uganda (e.g. in balancing personal priorities) could be eased. He noted that providing capital directly is of course also useful for this, but can carry the risk of actually making the venture less competitive: an entrepreneurial effort might become focused on access to donor cash rather than on becoming self-sustaining.

Support for engaging potential institutional customers would be useful, for example in terms of setting up meetings or workshops with potential clients. Another example would be simply to give innovators some affiliation to a well-known programme in order to give them a better chance of organizing such connections themselves.

Technical support could also be useful in some development stages, to shortcut the process of designing equipment.

9.19 Respondent 19

Researcher, Artificial Intelligence in Developing Countries (AI-DEV) Research Group, Makerere University

9.19.1 Description of innovation

Fast, accurate information about viral crop disease is needed to help lift farmers out of poverty and prevent famine. Currently crop disease survey is done by highly trained experts touring the country taking notes. This is expensive, slow and can only cover relatively small areas.

The Respondent together with other members in the AI-DEV built a computer vision system based on camera-phone input that provides a more efficient solution. Given some training and a basic camera-phone (common in even the most rural areas of Uganda), farmers themselves can provide data in the form of images taken of their crops. Applying computer vision techniques to large sets of such uploaded images, we can automatically classify the state of health of plants, and then map the extent of the disease in a district or country. In this way, more data can be collected, more rapidly and at lower cost. Pilot results of this can be accessed at http://cropmonitoring.appspot.com.

A related innovation was a phone application that can be used to do auto-diagnosis of cassava Mosaic Disease (CMD) simply by pointing the phone to the plant. A farmer in a remote area can obtain the disease status of his crops without the need of an expert. This information while being nominally important for the farmer, when sent to the central repository accessible by the government (in this case represented by National Crop Resources Research Institute (NaCRRI)) is important in determining the state of health of cassava plants within regions of the country which aids planning and proper forecasting.

A relatively smaller though non-trivial innovation within the system is the automation of one of the most labour intensive survey operations carried out by monitoring teams from the government—counting whiteflies on a leaf. This is a time-consuming and exasperating task when done manually, as the whiteflies are numerous on some leaves and highly mobile. Computer vision techniques are implemented on a mobile phone to do the automated counting.

9.19.2 Potential impact

Non-experts can use the mobile data surveillance system; it makes real time information available and reduces survey costs by up to an order of magnitude. If the system is deployed and used by the government (NaCCRI) then projected savings are huge because it frees up the experts time to concentrate on other critical work (as opposed to traversing the country doing a survey). The system also avails information in real time so proper mitigation planning strategies can be put in place. It also offers several other fringe benefits for example the auto-diagnosis app on the phones can be used by farmers and extension workers to get an idea of the health of their crops by using a phone and the whitefly count application automates a very tedious task.

9.19.3 Progress

The system so far is at prototype stage and preliminary field trials have been carried out in crop fields around Namulonge (around the research center) using the actual experts from NaCRRI. The data collection system is fully developed and has been tested to work with the experts. The auto-diagnosis system has been prototyped for diagnosing Cassava Mosaic Disease and accuracies are in the region of 92%. The whitefly count application has also been prototyped and tested with accuracies of about 85%. More work still needs to be done to improve the accuracy of the system as well as add other crop diseases to the diagnosis stack.

9.19.4 User reaction

The Respondent indicated that there was a very positive reaction to the surveillance system by the government (NaCRRI). NaCRRI funded the training of the local experts at the research center in the use of the system as well as the pilot field test in the cassava gardens around NaCRRI. Several suggestions were made by NaCRRI on additional components to be added to the system for example the whitefly count and an application to determine the proportion of necrotized root from the cross-section of a cassava tuber. This kind of feedback was deemed as positive reaction to the system.

NaCRRI for two years in a row promised to use the system together with their current system so that results of the interventions can be compared. While this has not happened for a variety of reasons, this is still deemed a very good reaction. The mobile surveillance and diagnosis system has also been chosen as a finalist innovation application by two innovation competition panels; Pivot25 and ACIA awards 2012.

9.19.5 Resources available

The project was initially started as a research project under the the AI-DEV group (http://www.cit.ac.ug/cs/aigroup/) with a Google Research Award of USD 12,000. This facilitated the purchase of phones for testing, the data airtime, travel, and development costs for some components of the system. Limited support was also obtained from NaCRRI in terms of availing their experts for training on the system.

9.19.6 Obstacles

The project has been at prototype stage for a period of about a year now. Despite promises by the leadership at NaCRRI to test drive the system by using it in an actual survey for the last two national surveys this has not materialized. At one point when this seemed imminent, training of experts was done, the AIGROUP purchased several phones, data airtime for the phones was purchased but this did not go to fruition. The obstacle here appears to be two-fold; one, with the bureaucracy involved in getting the survey to be carried out, some years government has cancelled or postponed it due to lack of funds, and two, when it comes right down to it, the top management of NaCRRI is hesitant to try the system alongside their usual survey because of the perceived amount of time that will be wasted in carrying out both systems. However these were speculations from the Respondent, it was not clear what the real obstacles were especially since NaCRRI seemed committed to the system.

Another possible obstacle the Respondent specified is that several people befit from the paper-based survey in its current state for example the experts and drivers that get the per diems, the supervisors that get allowances, plus all the other people who benefit through the purchase and sale of the consumables related to the survey. Government institutions generally tend to have "special" relations with suppliers from which some of government officials get some commission. Having a system that cuts out the need to purchase paper, fuel, vehicles, boots,

raincoats and other items used in the current survey system is bound to have some challenges in taking it up.

Also relatedly, the managers have some misgivings about the system being that it is new, and has not be implemented and tested elsewhere. At NaCRRI several other systems have been introduced by other "innovators" for example the pen recorder that digitally captures anything written using this pen. These have not been too successful hence lending some skepticism to the crop surveillance system.

Funds to support the researchers in the form of stipends are lucking. Being faculty at Makerere, which pays unrealistically low salaries means the Respondent and team have to spend some time, devoted to pursuing extra-cash activities. This limits the amount of time spent on research. Funds to buy more equipment and do more test studies to increase the confidence of the managers are also lucking.

9.19.7 Useful support

The Respondent thought some support in terms of funding would go a long way in ensuring the system achieves accuracy levels that can support deployment. Also funds to support collection of more data related to other diseases would make the system more widely usable and probably more acceptable to NaCRRI the key beneficiary.

Dealing with government bodies tends to be an arduous process because of the bureaucracy and the sluggishness associated with government bodies. The support in the field of lobbying line ministries or government bodes to take up the system is also required. Serious field test trials of the system have stalled because of this weak commitment from government bodies in this matter.

9.20 Respondent 20

Director and Co-Founder Cypher256, Developer of WinSenga Application

9.20.1 Description of innovation

WinSenga is an antenatal diagnostic system that comprises of a modified pinard horn and a Windows mobile application. The horn is placed on an expecting mothers belly and the sound is transmitted to the mobile application that processes the sound to detect the unborn child's heart rate. From the heart rate obtained (in beats per minute), the application can alert the midwife of any anomalies and provide possible suggestions of what possible diagnoses can be made.

The team is also building a holistic WinSenga suite of applications around the WinSenga system. For example with the proposed new system, a mobile application is used to capture details of expectant mothers during each antenatal visit and the application can offer suggestions to the

midwife about when the mother may need to eat foods with iron or certain vitamins. The system will also be able to send an SMS to the expectant mother with results from her antenatal visit.

9.20.2 Potential impact

WinSenga will mainly be a tool used by midwives in antenatal clinics. It aims to offer an easy to use affordable and effective antenatal diagnostic tool. Current tools used are either too expensive to be affordable to majority antenatal clinics or too rudimentary to provide sufficient accuracy. For example midwives in remote antenatal clinics use a pinard horn and a wristwatch to try and detect the heart rate of unborn babies. This process tends to be failure prone given that the rate can be confused with the blood pressure in the aorta that passes over the mothers belly, it gets quickly irritating for the midwife to keep listening to every expectant mothers belly and its cumbersome to use. The Respondent and team in a recent survey found the effectiveness of such rudimentary systems can only be attained for midwives with at least 10 years experience in the field.

9.20.3 Progress

The WinSenga diagnostic system is at an improved prototype stage. They plan to launch a beta version of the system that will be used for the first preliminary testing with expectant mothers. The project was started in December 2011 while the group members (3) were still freshmen at University. It came to light internationally and nationally when they entered the Microsoft Imagine cup in 2012 and were the best innovative group from sub-Saharan Africa. They have since re-written the system to incorporate new development routines. The first version of the system at deployment is expected to cost between USD 250–350 compared to the nearest cheaper alternative on the market; the Doppler fetal monitor which costs about USD 600.

9.20.4 User reaction

The WinSenga team carried out a survey with approximately 30 midwives and introduced them to the product. The midwives had positive reactions towards the system but are waiting to see how it will actually work once deployed.

The team did not interface with clinic owners so it is unclear whether clinic owners would be willing to take on this tool. Since clinics will be the primary users of the system, this still has to be established, but if the midwives think it is very useful, the WinSenga team thinks it is likely the clinics will take it on.

9.20.5 Resources available

The project was started by the team while at university, the only resources they were able to access where the ones given them by their parents. After entering the application into the Imagine cup competition and winning an award for top African innovation, the team formed a company; Cypher256 that applied for a Microsoft grant and were awarded USD 50,000 at the

end of 2012. Resources have been used to recruit 3 other staff to do the marketing and business planning as well as further the development of WinSenga.

At about the time the team entered the Microsoft Imagine competition, they were recruited into the Microsoft Innovation Center (MIC), which is an innovation accelerator with a bias towards Microsoft products based innovations. MIC offered mentoring as well as technical support on different aspects of the WinSenga project.

9.20.6 Obstacles

One principle obstacle that the team is facing is related to the fact that their innovation is in the clinical health sector. For any testing to go on they have to get permission from the medical ethics committees of the Ministry of health and of the hospitals where they want to do the testing. The bureaucracy associated with this process has stifled the progress of the team.

Closely related to this is the lack of support from the university and government. The team expected that after representing the whole of Africa and being recognized internationally the University and Government would pick interest and take this further but they were quickly disappointed. Even getting permission from within the University (the Medical School) to carry out some trials is proving to be very cumbersome.

A problematic mentorship model under MIC was also highlighted as a big obstacle. Because mentorship from MIC is done by volunteers from outside the University, the mentorship tends to be a 'strings-attached' kind of mentorship. For example once the team won the grant of USD 50,000 to develop the application further, several mentors wanted 'their cut' of the deal and refusal to give them 'their cut' has led to some friction. The group also reduced from 3 to 2 because of issues related to sharing the grant.

Lack of proper skills was also highlighted as a limiting obstacle. The team has had to deal with buggy code and rewrite the code several times just to be up-to-date with professional standards of coding. Proper mentorship at an earlier stage would have mitigated this.

Funds have also been cited as a limiting obstacle. Presently the two co-founders and developers of the WinSenga system are both employed with other regular companies. This was a necessary step given that they had to meet their day-to-day needs of transport, feeding, housing, etc. The fact that they have regular 8–5 jobs means they have less time to continue the development of the system. With the grant they were able to hire some skeleton staff and one of them is planning on resigning his regular job to work full time on WinSenga.

9.20.7 Useful support

Funding support was highlighted as the most meaningful and useful support they presently need to pay out salaries and do the marketing for the product. With proper funds the Respondent indicated they would willingly resign from their regular jobs and concentrate on WinSenga.

Mentorship was highlighted as an important aspect of support especially for probable innovators like the Respondent and his colleague. They thought starting mentoring at an even lower level for example in secondary schools or early in University for example at freshman stage would afford the teams more undivided attention to the innovation before other pressures of life set in.

Support from Government and key institutions for example the University were also highlighted as being critical. This support could be in the form of creating collaborations with key beneficiaries of such innovations for example in their case the Ministry of Health in Uganda.

9.21 Respondent 21

Head of AI-DEV Research Group, College of Computing and Information Sciences, Makerere University

9.21.1 Background

The Artificial Intelligence in the Developing World (AI-DEV) group applies computational techniques from the fields of machine learning, image processing, natural language processing and optimization in order to find solutions to problems in domains such as health, agriculture and resource allocation. The group collaborates with universities in several countries, with strongest connections to the University of British Columbia, Groningen University, The University of Edinburgh, The University of Sheffield and Tokyo Institute of Technology. Currently the group has three faculty, four PhD students and several MSc and BSc students with active projects. Collaborators from overseas are involved either by co-supervising PhD students, visiting the group physically, or giving seminars remotely by video conference. Weekly group meetings and individual student supervision sessions are used to track progress.

Active projects currently involve automated laboratory diagnosis from blood smear images, low cost solar traffic congestion monitoring units using video processing, analysis of remote sensing and climatic data for predicting changes in food production and disease transmission, crop disease monitoring (described further in the feedback from Respondent 19) and auction design (described further in the feedback from Respondent 23).

9.21.2 Innovators

Postgraduate research students tend to have spent longer in their careers before beginning studies compared to their counterparts in Western universities, particularly PhD students, who have usually spent several years in technical or managerial positions, and they usually continue their jobs in parallel with their studies. This is because most students pay their tuition privately—it is only professionals who can afford this (family members do not support PhD or MSc study as readily as they support undergraduate study, and funded scholarships are almost unknown at Makerere). One consequence of this is that postgraduate students have good links

with industry and government through their previous or current employment. Another consequence is that all postgraduate students are part timers. The situation for faculty is similar, since salaries are low, so senior staff often spend only part of their working week on academia.

At the beginning of studies, the concept of research is often weak, and the idea of producing a high quality product has to continually reemphasize. The first year of a research programme can therefore be an exercise in confidence-building, persuading students that they are capable of internationally competitive research. Perhaps as a result of teaching styles at undergraduate, secondary school and primary school levels (rote learning and punishment for making mistakes in mechanical tasks), it can be difficult at first to encourage an attitude of creative problem solving.

9.21.3 Progress

Two systems developed in the group have been covered in the responses from other informants (Respondent 19 and Respondent 23).

Some of the more analytical work, in methods for predicting disease spread and food production from telecoms and remote sensing data, have had some academic impact in terms of publication, but so far close to zero practical impact. This work was carried out with advice and data from personnel at the Ministry of Health epidemiology unit, the Makerere--UCSF Malaria Research Collaboration, Uganda Telecom, Orange Uganda, Kampala City Council Authority and the Uganda Bureau of Statistics.

Automated laboratory diagnosis, particularly for diagnosing malaria, is in a stage of user trials. The group is now partnering with Kampala-based 3D printing company OmusonoLabs with the aim of commercializing the platform. This system has been trailed in Mulago Hospital (Kampala), Makerere University Hospital and Lacor Hospital (Gulu), during the three year development period so far.

Low cost traffic congestion monitoring is at a prototype stage. The latest physical prototype costs around USD 150 for all parts, and around six months of data collection has been undertaken to evaluate the accuracy and cost-effectiveness of the system for Kampala traffic conditions.

One example of a fully deployed and actively used system is an internal project to carry out timetable creation in the College of Computing and Information Sciences. This was actually not a research project, but undertaken simply to make life easier for teaching staff. Creating timetables in the College was previously done manually with Excel spreadsheets, which was a near-impossible task given >100 teaching staff, >500 lectures per week to schedule for >6000 students and several hundred time and space constraints. Timetables were routinely available weeks after the semester had started, had many conflicts (lecturers were in the habit of 'camping out' in rooms by arriving early in order to have first claim in case of double booking), and a previous registrar assigned this task resigned due to the pressure. A system developed to

do this automatically, based on light customization of some open-source scheduling optimization code, is now routinely used (see http://cit4.mak.ac.ug/timetables/) and is being replicated at Mbarara University of Science and Technology. It cuts down conflicts to zero, has personalised timetables for individual lecturers, and allows printing of room usage timetables to pin on the door of each lecture theatre and give to custodians. Going back to the manual system is now unthinkable.

9.21.4 Input in concept formation

Usually the initial concept is outlined for research students. The assumption at the beginning of a programme of research is that the students are not yet equipped to formulate a research direction themselves, though they should be able to fill in the details given a general description of an interesting problem. For example, the crop disease monitoring project started by suggesting to a PhD student (Jennifer Aduwo) that visual diagnosis of infectious diseases on the leaves of crops could be a promising area; the student then narrowed down on a particular crop found domain experts to help specify the problem more completely.

9.21.5 Input in implementation

Implementation work can be divided into two parts: there is a methodological aspect, in which students require advice on algorithm development or mathematical modeling. At the beginning of studies, quite detailed input is required (weekly meetings). Since the aim of the study programmes is to produce self-sufficient researchers, this input tails off towards the end of the project. In terms of the practical side (data collection, implementation of software, field trials) little input is needed, as the students have enough experience to carry this out on their own initiative.

9.21.6 Resources available

The group has had a series of small grants (mostly in the USD 10,000--30,000 range) from industry: Google, Microsoft and IBM. Carnegie also provided funding for the crop surveillance project, and there has also been internal funding from the College of Computing and Information Science. The main benefit of this funding has been (1) to pay stipends to students in order to free up their time, (2) to fund travel in order to give students vital exposure to the wider research community.

The College and School management have been supportive in terms of reducing teaching load where possible, assisting with administrative details of grant proposals and hosting visitors.

The timetable system was an unfunded, voluntary effort, but took advantage of open source software which largely solved the problem.

Collaborating universities provide useful resources such as access to online journals and computing server time, as well as hosting AI-DEV students on visits.

9.21.7 Obstacles

There is a tradeoff between producing academically publishable work and having practical impact. To go from a publishable proof of concept to actual engagement with end users requires a lot of work which does not carry much academic credit. Since one of the immediate goals of the group is to train researchers, and yet the credibility of the work rests on practical results, this is a difficult balance to strike. There is a related issue in terms of technical sophistication: because of the requirement to graduate PhD students, and thus to publish work in conferences and journals, this means that projects have to be at a level of complexity which might actually be overkill for the task at hand. Overcomplicated solutions are clearly less likely to be adopted in the long run, and computing research is full of complex solutions looking for problems. This dilemma has been reduced recently, however, with the emergence of 'ICT for development' (ICT4D) as a new academic discipline, in which developing-world impact is valued over technical sophistication.

For staff this balance is difficult as well. The promotion system at Makerere rewards numbers of publications—it is the main metric used for determining eligibility for senior academic positions---but 'contribution to community' is rewarded much less.

Technical research and innovation culture are somewhat new in Uganda: there was negligible computing research output from Makerere five years ago, and only a small amount currently. The research impact of the entire College of Computing and Information Sciences is probably less than that of a single faculty member at a top US university.

Systems which do not either make money or reduce expenditure tend not to be self-sustaining. For example, while interesting ideas abound for improvement of clinical decision support using computing methods, if they involve an extra financial burden on the end user for maintenance or equipment procurement, this sinks the project as soon as financial support for development and testing is withdrawn.

The work within the AI-DEV group which has had least impact has been decision support for planning, disaster response and resource allocation. This could be because the decision makers involved aren't really interested (e.g. because there are already plenty of advocates trying to have influence in the same area, or because allocation of some resource is partly a political calculation, not just based on need). The experience has been that there is not a great understanding or confidence in the use of modeling or computing methods, so this can be a difficult sell. Furthermore, especially in the public sector, there is a suspicion of computing technology. This can simply be due to worry about people being replaced with software. However another reason is that the institutionalized corruption which permeates the public sector relies on a haze of plausible deniability that is threatened by automated, computerized systems. This type of effect causes resistance to particular projects, moreover from the people whose cooperation is most vital for success. This has led to some AI-DEV projects being abandoned at an early concept stage.

Research students are effectively part time due to financial constraints; progress on implementation takes longer than it would in a well-funded university.

9.21.8 Useful support

Enthusiastic, influential collaborators who represent the end user (and articulate the needs themselves), are the most important asset to a research project for it to have practical impact.

Funding to pay student stipends also has a big effect on productivity, but only in cases where the student has already proven their ability and perseverance by demonstrating progress without any financial support. This also helps provide the stability needed for students to plan over long time frames. Although the technical aspects of an idea can be completed in weeks or months, ideas need to be pushed with users over a time scale of years to get traction.

For students to become immersed in research culture, visits to conferences and the labs of collaborators are useful (in the case of conferences, only if the technical quality of the programme is high enough—many are a waste of time). This does not have to be travel outside of Africa, since the calibre of regional research is increasing.

9.22 Respondent 22

R&D Director and Founder, PSM SchoolMaster Solutions

9.22.1 Description of innovation

PSM SchoolMaster Solutions is an innovative integrated IS solution for schools that enables them automate most of their repetitive tasks. It is essentially packaged for secondary schools and integrates the students' academic records with the school disciplinary records system, school health system and library system. It is also linked to the staff information system, and the finance system. In 2011, PSM also integrated a mobile system called MyChild to their system that enables parents to access their children's records (results, disciplinary, etc.) via the web and via an Android app.

SchoolMaster solutions started in 2004 with at team of 7 graduates from Makerere University, majority of who were from the then Faculty of Technology, Makerere University. By the end of 2006, the group had disintegrated as several of them moved on to better paying jobs. The Respondent stayed on and built on it intermittently amid several challenges till 2008 when it got its first clients. He has since improved the system, rewritten it, employed 2 extra staff, registered a company and established an office.

9.22.2 Potential impact

The main impact is in terms of automating and integrating the numerous tasks in institutions of learning especially secondary schools. Many schools and institutions of learning still use basic

computer applications like MS Excel to capture and store student's details (results, finances, disciplinary issues, etc.). This system automates all this and enables parents to access the status of their children's progress remotely via web or mobile app.

9.22.3 Progress

The system is in its production phase and has grown in subscription from 10 schools in 2011 to about 27 schools including St. Peters Naalya, Mt. St. Mary's Namagunga as well as Uganda Institute of Computing and Technology (UICT), a tertiary institution. Their recent client is the Aga Khan group of schools.

The coverage is however still low, given the numerous schools in Uganda. The company plans on marketing the system within the East African Region and making it the predominant school system in majority of the schools in the region.

The current pricing of the system is based on how much customization needs to be done but ranges from USD 800 for a regular secondary school to about USD 8000 for Universities. They also levy an annual support and upgrades fee to each of the clients. Their newest project MyChild is sold to the parents of the children in the schools where the system is installed and for a termly fee of USD 20 they can monitor their children's' progress remotely.

9.22.4 User reaction

At the first marketing of the first version of the system in 2007, 5 schools liked the system and bought it. Several other schools were hesitant to take on the system because it was a local system built by students just out of university. As part of the sale, the company had to pledge to enter all available students records into the system at no cost as well as offer support per term during results handling season at the schools.

Presently they have close to 27 schools signed up and using the system. Their recent product MyChild received a lot of acceptance from parents in the schools where the system is installed. With this product the parent gets an update on his child as well as some simple analytics about the performance of his/her child.

9.22.5 Resources available

Initially the team borrowed a no-interest loan of about USD 500 which was used to set up an office but they quickly run out of funds and most of them abandoned ship to look for ordinary salaried jobs. The development of the system has effectively taken seven years from 2004 to 2011 with several points in between where the Respondent gave up on the system but because of support concerns from the schools using the system had to come back. The Respondent has more or less single handedly written and re-written most of the system. New recruits in more recent times have also helped in the development of the system.

About 2008, the Respondent by then the only remaining member, partnered with someone else

who was to do the marketing and the Respondent the coding. By this time the Respondent had obtained a regular salaried job and was supporting the company from his salary. The partnership did not last long and they soon parted ways at which point the Respondent formed a new company and took on the development and management of PSM SchoolMaster solutions single handedly. Using his salary from his regular job he employed 5 employees to do the marketing and the coding of the system.

Despite the 27 clients, the Respondent has had to keep supporting the company from his own personal funds (salary). He even sold some of the shares in his company as well as offering the employees some of the shares in the company as a way of motivating them. The Respondent contends that if some of the schools had not continued requesting for support and improvements, he would have given up on PSM a while back. Presently PSM is setting up a reasonable office from some of the new contracts they have obtained. What is lacking is marketing.

9.22.6 Obstacles

Some of the early challenges were that the users were skeptical about the product and the developers given that they were new graduates with no office to talk of. Issues of support and maintenance were the major concerns for the clients then. The also had to keep the product reasonable priced so the schools could afford it (approx. USD 400–700) which by then for a team of 5 was hardly enough to pay even the day to day expenses of running the office.

Earlier on, there were also problems of unreliable electric power, lack of decent computers to work on and poor and very expensive internet access. The Respondent indicated that at times they could not meet client deadlines because of long power black outs and when they had issues with the development, accessing internet forums was a problem because of the expense involved.

Leaving university, they also had insufficient technical skills in professional software development. Looking back the Respondent identifies this as one of their limiting factors. The Respondent also highlights this as still a prevalent obstacle in this day because his interactions with the outputs from the University system have been disappointing. He claims the students lack determination, the ability to follow through with work and a poor attitude in spite of the vast amount of resources over the internet and presence of all the available innovation platforms, e.g. innovation hubs, hackathons, etc

Other obstacles he identified included the lack of sufficient funds to take an innovative product from inception to market. The initial team disbanded on these grounds as team members went on to look for regular salaried employment. Even the Respondent who stayed on eventually had to get a regular job as well just to be able to live a decent life in Kampala and take care of his brothers and sisters who were depending on him. Funds to furnish a decent office, to pay for the marketing and pay employees are also badly needed for innovation to thrive.

In recent times, depending on who makes the introductions to the head teachers, the Respondent experienced some instances where the IT teachers in various schools require some monetary facilitation to endorse the product or link the company with the relevant head teacher.

One other highlighted obstacle was that parents have different ambitions for their children and often do not see startups and innovative teams as gainful employment. They are more inclined to press it upon their children to get jobs in banks or other well-established salaried employment industries.

9.22.7 Useful support

The Respondent recommended that innovation should be stimulated and initiated while students are still at University and do not have to worry about all the financial obligations that a graduate from University will immediately be faced with. The team is also more cohesive in University because of the same reason.

Funds for setting up a reasonable office where sales pitches can be made, where actual development work can be done are crucial. Also funds to aid in marketing and paying salaries were identified as key for innovation to thrive.

9.23 Respondent 23

Founder and Director, Kudu Enterprise Systems Integrator and University Lecturer

9.23.1 Description of innovation

Kudu is an auction market for agricultural produce, which began development in Uganda in mid-2010. The project started as an investigation into challenges for agricultural markets in Uganda and later on developed into an auction market to support agricultural trade using SMS messages for mobile-phone subscribers. The web interface is available at http://kudu.ug.

The project was initially piloted in 5 districts in the Uganda, and these were Masaka, Sembabule, Bukomansimbi, Kalungu and Kampala. The first four districts were chosen because of their reputation for trade in coffee and other produce such as maize and beans which were thought to be easy to define. Kampala being the main district that hosts majority of produce traders, it was also included for feedback from traders. In January 2013, the project was expanded to a wider audience in the country through radio advertising that was done once a week mainly broadcasting to areas in the central and South-Western regions of Uganda.

9.23.2 User reaction

The project has been successful based on the trials so far (main phase begun in January 2013).

Kudu has over 1000 farmers and traders enrolled. Farmers have submitted produce on the market worth over USD $1.5M and traders have submitted requests close to USD $1M. These figures showed that the system is helping farmers to find markets for their produce and also helping traders to readily find produce to buy.

The market has been operating through an SMS short-code (8228) and each message goes out to users with the Respondent 's phone number which is available for users to call in case they needed help. The Respondent received passionate calls from farmers thanking him for helping them to sell their produce. In some cases farmers would call in desperate desire to sell their produce after they had failed to get buyers.

9.23.3 Resources available

A Google Research Award of USD 27,000 funded the development and initial trials. Part of this was used to pay a monthly stipend for the Respondent, as well as operational expenses such as payments for server space, marketing on radio, transport to the markets and upcountry for farmer meetings.

The monthly stipend was crucial in keeping the Respondent focused on the project without having to worry about feeding and transport costs. He had previously worked on projects where sometimes he had to choose between instincts to survive and passion for the project objectives. In the case of Kudu, the choices were not that difficult, as he didn't have to negotiate on whether to avoid a certain meeting because of transport costs, or to take up part-time to meet personal expenses. The Respondent also had employment security through a long-term contract with Makerere University which kept work on Kudu stable. Even when he knew that the money from the Google project was not enough, he had hope of income from the University. He was also not very worried about the prospects of the project failing. Sometimes people quit due to the fear of failure, but he had confidence in the idea and the team, in which questions and their questions were answered with truthfulness.

Having a large social network in the IT business helped in getting assistance from friends. The SMS service for example was required to be highly reliable and responsive. Most SMS service providers do not care much about this since their applications design do not demand timely responses. The SMS service provider helped to have the SMS platform running as desired. This request required the contact at the SMS provider to work beyond the call of duty or contract terms to ensure that the project was a success. The Respondent notes that other forms of help were needed from friends and partners.

Another success factor was his individual aspirations. He has always liked working on exciting new technologies in an environment where he could express his imagination. This desire kept him going in the face of difficulty. After spending a lot of time working on something, the best bet is to get it working to a certain level of success so that all is not lost.

9.23.4 Challenges

Research project money through Makerere tended to take a lot of time to get cleared. Business tends to have the urgency of now. Running a real-life business requires more flexibility than what is practiced in the bureaucratic university environment.

The market has seen more requests from the supply side (farmers) than the demand side of traders. The Respondent thinks this imbalance would be solved with more advertising.

9.24 Respondent 24

Founder and Lead Organizer, Mobile Monday Kampala, and Director, Hive CoLab

9.24.1 Background

The Respondent has 17 years of experience of the technology scene in Uganda. He has personal experience of innovation particularly in education, and has strong links to government and industry in Uganda. In recent years he has been increasingly involved with different initiatives aimed at building an innovation culture in Uganda and East Africa, such as hackathons, startup weeks, and innovation competitions.

The Hive CoLab continually hosts entrepreneurs, developers and researchers from outside Uganda, which provides a source of informal mentorship for those using the facilities.

9.24.2 Innovators

The essential personal qualities the Respondent looks for are difficult to define, but involve an aspect of risk-taking, the ability to take authority, spontaneity, and readiness to work on gut feelings. Finding the right people is key, and difficult. He comments that academic preparation in Uganda is lacking—while there are several thousand graduates each year, the majority of them are lacking the skills and initiative necessary to pursue their own innovation, and many are unemployable altogether. The training provided by Ugandan universities is haphazard, for example with no continuity from internships.

However, promising innovators can be found by providing a conducive environment in which they can raise their profile.

9.24.3 Stages of progress

The informal nature of Hive CoLab and MoMoKla makes it difficult to have visibility into the progress of specific groups. This is an issue they are trying to address. [Note: the Hive CoLab site http://hivecolab.org does list some of the teams that have worked under its auspices, largely companies which offer consulting and media services].

The Respondent views the progress of the CoLab and MoMoKla more in terms of setting up an

environment necessary for innovation to flourish. Flagship successes he has been involved in are for example Pivot East, Infodev contests and the World Summit Awards, which are aimed at providing funding and recognition to startups who are at a stage of progress where they are ready to attract venture capital.

9.24.4 Input in concept formation

Groups involved with the Hive CoLab arrive with their own concepts. Rather than directly suggesting ideas, the idea is to provide a venue for ideas to be shared, and for teams to form through these interactions. Mobile Monday presentations generate ideas on particular themes, e.g. technology and agriculture, with audiences of 160-180 people. Weekly technical talks at the Hive CoLab also generate ideas on a more focused setting, with typical attendance up to 25 people.

9.24.5 Input in implementation

The Respondent 's input is mainly to provide connections between startup teams and people who have resources or advice they need, or who might become clients. The CoLab is a very open facility, where individuals and teams are free to come and go, hence there is a light touch in terms of mentorship. Specific advice again comes from feedback at seminars, at which project teams have an opportunity to present.

9.24.6 Obstacles

Links between academia and industry are not very strong in Uganda, hence there is wasted potential.

Getting things done with government can be a challenge; certain ministries are lacking the dynamism necessary to push forward useful innovations. Sometimes there is a different challenge with government, where a department or individual is keen to be involved in an initiative but then hampers it with too much bureaucracy.

More work is needed on filling the gap after events such as hackathons. A lot of energy is generated on specific projects in a short period, and there is still a question on how best to keep the momentum going afterwards.

9.24.7 Useful support

Funding should be tied to outcomes. When work has reached an agreed standard, and has been vetted, then it should receive support. However, funding to enable creativity is also necessary—a balance has to be struck between these two goals.

There are successful cases of stimulating innovation in Africa, such as RaizCorp (http://www.raizcorp.com), a very large and prolific incubator based in South Africa. It might not be a bad strategy to simply duplicate their model. AppCampus (http://www.appcampus.fi), which provides a combination of funding and coaching to developers, is another good model.

Institutions of these kinds are useful, even if they are non-geographical.

Specific training is useful for startups to fill the skills gap. For example, the kind of training offered by eMobilis (http://emobilis.org), which combines exposure to technology as well as entrepreneurship training, directly addresses key bottlenecks for innovation in Uganda. It is useful for key leadership of startups to be sent on accelerator training courses.

9.25 Respondent 25

Co-founder and Program Director at Outbox Uganda

9.25.1 Background

Outbox is a technology incubation, collaboration space and innovation hub that supports software developers and technology enthusiasts to turn their ideas that utilize mobile and web into sustainable businesses. Outbox's mission is to create awesome products and businesses on the mobile and web that create value, relevance and are sustainable.

Outbox aims to support 3-5 mobile and web businesses from the idea stag to investment readiness for a period of six months. During this period mentors provide coaching in business development, strategy and marketing of products and services. OutBox started an incubation program in Uganda about two years ago—the incubation program is supported by Delloitte, Google, Samsung, Everlytic and PivotEast. These companies offer financial support to Outbox and also provide mentors that are available on call whenever a mentee needs advice or technical support.

The Respondent is a co-founder and lead manager at Outbox Uganda. He has managed several startups including SMSOne and managed several technology forums on behalf of Google, Microsoft, Garage48 and Delloitte. The Respondent has set a good example of managing, marketing and getting international and local attention towards Ugandan ICT community. The Respondent holds a Bachelor of IT from Makerere University. The Respondent has supported several startup projects and the most successful has been a music content web application.

9.25.2 Innovators

Outbox provides mentorship to any individual or group that has a business idea or project with potential for being a business success. Outbox has for example provided workspace to groups of students that developed the Mafuta Go application and WinSenga. Outbox provided them with technical and business coaches to make help in furthering their ideas into business success.

All these groups were formerly students from the college of computing and IT, that had their projects developed before joining Outbox. All these projects needed further development to make them business ready. This process required further functional analysis and business strategy development to prepare them for success. All these projects reached preliminary trials

with end users.

9.25.3 Input in concept formation

In the majority of the cases innovators come to Outbox with their ideas and typically need help to further their implementation into a business success. Incubatees in Outbox have to compete for the few slots available. They compete using the ideas they have developed or those that they wish to develop for the available slots. An evaluation is done by an Outbox team to determine those to take up into the program.

9.25.4 Input in implementation

Projects that have not been already developed typically require a step-by-step guidance from a mentor. Projects that have already been built are supported through suggestions for market penetration and growth. Some startups only want space to use after completing University. Many fresh graduates need working space for a decent office that they can call their company home. In case of business success, they use Outbox space for meeting their customers and legal registrations.

9.25.5 Obstacles

Recruitment for mentees has so far been done through word of mouth and advertising posters pinned at campuses. Outbox plans on having more direct engagement with Makerere University through a Memorandum of Understanding to gain better access to a larger audience. This was not done in the beginning due to a fear of bureaucracies in the Makerere University administration.

The other challenge to mentee projects is marketing. It has been difficult for Outbox to make the projects known without an advertising budget. Some of the projects such as the music content project have not taken off because of a marketing problem.

The other problem is persistence of the mentees or innovators. The WinSenga team for example failed to stay with Outbox and the entire team opted to find employment despite having received financial support to develop their product. The reason given by the team was that they need to learn something new at their prospective places of employment.

Another group in a similar setting that developed the Mafuta Go project stayed with Outbox for more than a year and has gone on to create another application with potential of business success.

9.25.6 Useful support

Outbox is also now aimed at providing strong technical skills such as Agile software development techniques to enable developers work through challenging tasks. Many mentees also fail to relate technical and business value to the end user this is problem that Outbox is working hard with partners to solve in addition to project commitment. Outbox is looking

forward to hosting more projects to offer them structural, strategy and legal support.

The Respondent also thinks that partnership with universities on projects would work well to bring private sector experience to University environments. He observes that universities have little to lose since their core function is teaching—business comes as a secondary objective. In his opinion, public-private partnerships are necessary for achieving tangible business results. He notes that universities have a lot of bureaucracy but have students / human resources. He gave up on having a memorandum of understanding between Outbox and Makerere University after pursuing the matter for more than a year.