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Entrepreneurship Training for Scientists and Engineers in Developing Countries: A Report

Surya Raghu

This text details our efforts in building capacity for innovation and entrepreneurship among scientists and engineers in developing countries. Our fifteen years of experience indicate that the training program has a substantial impact, including the formation of an informal, international network of scientists and engineers. Scaling up these efforts would help foster a Science, Technology and Innovation (STI)-based knowledge economy in these countries as well as opportunistic international collaborations to provide innovative solutions for their many urgent and un-met societal needs. Some challenges faced by entrepreneurs in developing countries are also discussed.

Background

Science, technology, and innovation (STI) are key drivers of economic growth and play a major role in development in emerging economies. The ability of STEM graduates to convert their ideas into commercial products or services and start

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businesses to address their local market needs promotes self-employment and job creation and mitigates the "brain drain" in many developing countries. The success rate of such businesses or "startups" is to a large extent dependent on the entrepreneurial skills of those who start them. Providing such skills to early-stage and future entrepreneurs is the motivation for a number of international capacity-building programs. These include EMPRETEC by the United Nations Conference on Trade and Development (UNCTAD),[1] the Global Innovation through Science and Technology (GIST) initiative by the US Department of State,[2] the Start and Improve Your Business (SIYB) program by the International Labor Organization (ILO),[3] and the International Entrepreneurship Program by the Lemelson Foundation,[4] each an example of a successful initiative for entrepreneurial training across a large number of countries. In this article, we describe our own program, which specifically addresses the needs of scientists and engineers from developing countries.

During the 2005 World Conference on Physics and Sustainable Development in Durban, South Africa, a resolution was adopted under the theme "Physics and Economic Development," for the:

> … establishment of a training program for physicists for the application of economic development in developing countries. The purpose of the training program is to provide short courses of probably four weeks' duration to provide physicists from developing countries with commercial awareness and skills... The course will be piloted at the Abdus Salam International Centre for Theoretical Physics (ICTP) (in Trieste, Italy).[5]

The first 5-day workshop on "Entrepreneurship for Physicists" was conducted at ICTP in December 2006 with the Institute of Physics (UK) as the co-organizing institution. Fifteen years later, there have been 35 more workshops in approximately 20 developing countries, with additional financial/hosting support from many partner organizations.[6] The program has served over 1500 participants from more than 60 developing countries.

Our training program

Our target audience is STEM graduates with aptitude for entrepreneurship, including senior-level undergraduates, recent graduates, Masters and Ph.D. students, and junior faculty and scientists at universities, research labs, start-ups, or established companies. The target number of participants in each workshop is about fifty, selected on a competitive basis. This class size allows us to have some group projects as well as personal interactions among students and mentors. Every

effort is made to have a geographically and demographically diverse and balanced set of participants. The age range is typically 22-40, and the male to female ratio close to 50%.

Participants are required to attend all sessions of the five-day workshop and actively participate in the discussions and group activities. Topics include networking and communication skills, the process of innovation, the identification of opportunity and market needs, the generation and protection of intellectual property, financial literacy, development of business models for converting market solutions into income, and the steps needed to start a company in their home country. All participants are involved in the preparation and presentation of a business pitch of their ideas on the final day of the workshop. International speakers to the workshop are selected based on their international experience with entrepreneurship; their skills in speaking, creating a presentation, and mentoring; and their passion to be involved in such activities. They also act as mentors and judges for the business pitch competition.

Outcomes and impact

A formal statistical measurement of the program's impact is difficult, due to the lack of a uniform system tracking all participants (the workshops are managed differently in each country). However, we have been able to qualitatively observe many program outcomes and impacts.[7,8] Based on the feedback from participants and our assessment of the business pitch that each group makes at the end of the workshop, almost all participants obtain a reasonable idea of the concept of innovation and entrepreneurship and the process by which an idea/invention can be taken to market. The participants also realize the importance of skills and knowledge around intellectual property, finances, and marketing for a successful start-up. These are shorter-term metrics – and we believe that tracking the longer-term impact is important as well, although the effects may be less tangible.

We are also pleased to report, with the limited follow-up we have with participants of the workshops, that several start-ups have been created in their home countries – Brazil, Colombia, Indonesia, Netherlands, Pakistan, Philippines, South Africa, Sri Lanka, Uganda, to name a few – and we believe that the workshops have had an impact on the rest of the participants as well. The transferable skills developed during the workshops have aided them in their careers even if they chose not to become entrepreneurs. Some of them have become key influencers in their home countries in the fields of entrepreneurship, technology transfer, and research commercialization.

Our workshops were also the seeds for developing entrepreneurship courses in curricula at several universities, which we supported. Another remarkable outcome of these workshops has been the international links created among participating scientists and engineers, which could enable better understanding and cooperation to address global challenges.

Factors affecting entrepreneurial success in developing countries

The innovative ideas for start-ups presented in their business pitch on the final day are evaluated by a panel of judges that included the workshop speakers and invitees with knowledge of the local business climate. The ideas are evaluated in large part for their viability. But the likely success of these ideas as start-ups are dependent on many local factors. as discussed below.

Entrepreneurial ecosystem

It is to be applauded that many developing countries are making serious efforts to build entrepreneurial ecosystems. In some countries, these are still below the level required for sustainable entrepreneurial ventures. Factors that determine the failure or success of entrepreneurial activity include government policies (for example, quotas for small businesses in government contracts or bankruptcy laws), access to finance (loans and start-up grants), entrepreneurship education and training, peer support, procedures for starting and conducting a business (bureaucratic hurdles, corruption, etc.), lack of physical and ICT facilities, and more. In some countries, the markets are very small and cross-border trade is too complicated (including IP protection) to sell in neighboring countries. Since entrepreneurship involves risk, some large government organizations hesitate to give contracts to start-ups – and occasionally, instead, they "borrow" the innovations and ideas from start-ups and then provide them to better-established "favored" companies to carry out the work.

IP protection and enforcement

The concept of IP and its scope are not very familiar to most of the participants. There are often very few examples in their home countries of people benefitting from IP generation and protection. The cost of IP filing and protection is exorbitantly high in relation to the local per capita income, making it comparatively more of a hassle to go through for a risky business start-up. At the same time, use of another's IP for the public good is not typically regarded as a violation of the IP rights of other companies. There are very few IP-trained lawyers and they are

very expensive for start-ups. Local and international IP enforcement for start-ups is almost unthinkable due to corruption and cost.

Outlook in academia

The attitudes of academics and roles of the university are often those that were set by the "old school" administrations (sometimes established by colonizing countries) – academic freedom for research and the open dissemination of scholarly knowledge. But these may conflict with the new requirements of IP creation, which include non-disclosure agreements and approvals by the universities' IP offices, which can delay publications. Many universities have not yet transitioned to translational research or developed criteria for promoting faculty that recognize patents, industrial collaborations, and start-ups as part of an academic career. Some universities still discourage interactions with industry and see consulting activities as a "conflict of interest."

Personal financial situation of participants

The personal (family) financial situation is an important factor in many of the participants' decision to pursue entrepreneurship as a livelihood. In two-income household, there is some wiggle room for one of them to pursue entrepreneurship. Single individuals without families to support but who need to earn a living are more likely to enter into entrepreneurship, but typically as a last resort, as a steady job is preferred by most. But there are typically not enough jobs for everyone and entrepreneurship is therefore often *a necessity rather than a choice* for many participants. Under such circumstances, failure can be very discouraging. For example, one participant who wanted to try a few entrepreneurial ideas was very discouraged when he did not meet success after trying for nearly two years, finally moving to another country to look for a job.

Cultural context

Several cultural barriers also need to be addressed for successful entrepreneurial activity. In many countries, a government job is not only a stable source of income, but it also a mark of prestige and power. By contrast, entrepreneurship is seen as the last resort of the unemployed. Further, many cultures are not failure-tolerant – failure in a business is a permanent black mark. A delicate balance has to be struck, therefore, between emphasizing the profitability of a business versus the perseverance to succeed; if there is an overemphasis on profitability, many first-time entrepreneurs shut down their businesses at the first setback forever. There may also be hesitation among youth to choose entrepreneurship as a career. In some countries, the word "business" has a negative connotation – it is seen as unlawful,

improper, and associated with corruption. Such perceptions have to be changed for successful entrepreneurial activity. Also, in countries where capitalism is not as politically popular or where there is an ongoing transition away from socialism, entrepreneurship is seen as a path to greed and wealth inequality.

National STI policies

The last point, which we believe is the challenge at the governmental levels, concerns the level of investment (amount and percentage) in STI programs and activities in developing countries by the government. Such investments are a factor in the rate of returns for the society. Noticeable returns often take a long time, longer than may be expected. This creates the perception that the benefits of science and technology are skewed towards developed countries – at least the initial benefits – and that they only later trickle down to developing and under-developed countries, most often as business and trade opportunities to the western world. A majority of the developing/under-developed countries have <1% GDP investment in their STI initiatives and hence do not have tangible results in short time scales or an incentive for further investment. This "Catch-22" is all the more problematic given their urgent socio-economic and political problems – and it is compounded by "brain drain," the outmigration of the most talented citizens to developed countries. It is a challenge to convince these governments to invest to build their scientific and technological capacities through STEM (science, technology, engineering and mathematics) education and related infrastructure.

Conclusions and future outlook

There is more work to be done to increase the impact of the program: a database and networking platform for of all the workshop participants could further enable them to address global challenges cooperatively. We also suggest scaling it up to have a larger impact, perhaps through intensive online workshops. Monitoring outcomes and gathering data as the program scales up would enable continuous improvement. More broadly, the gaps in the local ecosystems create a harsh environment for these start-ups to succeed, which needs to be addressed at the level of policy.

On a brighter note, our experience indicates that, there is always at least one feasible idea for a start-up in the 5-8 business pitches on the final day of the workshops, and the other pitches could be, with additional coaching. Given that they are developed in just four days, we consider this to be remarkable. Many transferable skills and tools that participants acquire bring a positive change in their outlook, something that carries through their careers. We believe this long-

term impact on the participants and multiplier effects are contributing to the growth of sustainable entrepreneurial and knowledge-based economies in their home countries. SD

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Endnotes

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