Enactus uOttawa and IEEE Ottawa Section Presents:

IEEE Humanitarian Initiatives: nurturing social enterprise through knowledge, technology and open innovation.

Alfredo Herrera wrote this case with guidance from Professor David Wright to provide material for the 2014 Strat24 Case Competition. The authors do not intend to illustrate either effective or ineffective handling of an engineering or managerial situation. Special thanks is extended to Raed Abdullah and Joan Kerr of the IEEE IHTC Implementation Committee and IEEE itself for making available the topic and data needed for this case. Please note all numbers provided are notional[1].

[1] Note that all numbers provided are notional and for the purposes of the 2014 Strat24 case competition.

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1.0 Introduction

The SIGHT program is the outcome of five years of sustained activities by IEEE members and staff to position the organization as a relevant Humanitarian contributor. Through an evolutionary process, the outcome is clear - IEEE members are enthusiastic to provide knowledge and support to civil society through the application of technology. Moreover, the drive to transform IEEE as a relevant contributor in this sector can now be seen in the recent emergence of IEEE's vision with regards to humanitarian action[2]:

> "to be a sustained contributor to solving global humanitarian issues through the application of technology. This is in-line with IEEE's core purpose *to foster technological innovation and excellence for the benefit of humanity*".

Hence, IEEE wants its Special Interest Group Humanitarian Technology (SIGHT) program to be the community where members and prospective members can:

- Inspire and be inspired
- Enable and learn
- Connect and collaborate within IEEE and with outside organizations
- Engage with the larger community interested in technology for development in-line with IEEE's vision to be universally recognized for the contributions of technology and of technical professionals in improving global conditions.

Much still needs to be done to operationalize IEEE's Humanitarian activities, however, current developments present an opportunity to use its vast membership knowledge to become a leader in the civil society sector. The challenges that Strat24 teams should address shall consider the following five major areas:

Operations

The concept of humanitarian activities was endorsed in November, 2014 by the Board of Directors, however, the actual 'how to' remains to be developed and implemented to carry out the required 'boots on the ground' approach: to establish a large global network of volunteers to carry out and/or support impactful humanitarian activities on the local level.

Branding

How does IEEE position itself as the 'go to' organization for civil society. Who are the clients? What are its competitive strategies? What needs are being identified? What are the promotional and social media material and campaigns?

[2] Closer to Development aid (ex: Millennium Development goals) than Humanitarian aid which is enshrined in international Law (Geneva & Hague conventions). For discussion, see: http://www.theguardian.com/commentisfree/2014/sep/08/doctrine-humanitarianism-not-benign

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Management

How will the strategy be managed? What are the technological and human resources needed to enter this space of collaboration and service offering? What partnerships will be engaged to implements projects on a global scale? What are the roles and responsibilities of IEEE and its partners?

IEEE Membership

How will IEEE engage the existing IEEE membership to participate and 'buy in'? How will this new initiative be promoted within the Association and garner volunteers, funding and continual support.

Evaluation

What is working? What needs to be improved? What needs to be addressed? What is the funding and training available for volunteers? What are the technologies that maybe more appropriate, affordable and accessible?

2.0 The IEEE's Organisation

What's important is that the IEEE is dedicated to advancing technological innovation and excellence for the benefit of humanity. Its Constitution [4] defines the purposes of the organization as for "the advancement of the theory and practice of Electrical, Electronics, Communications and Computer engineering, as well as computer science, the allied branches of engineering and the related arts and sciences."

To achieve this, it has a strong foundation and lots of clout built by its dedicated volunteers and, relative to the membership and volunteer base, a small group of staff.

The IEEE [1] is the world's largest professional association, with more than 430,000 members in more than 160 countries.

The IEEE is organized into ten geographic regions; member activities usually relate to one of its 39 technical societies, 10 technical councils or committees. An example of a society is the Communications Society. "Councils bring together groups of Societies to focus on a common area of technology" such as "Biometrics, or "Smart Grids." Committees exist at different levels and for an objective specific purpose; for example, the IEEE Special Interest Group on Humanitarian Technology Committee (SIGHT) [2], which supports IEEE member participation in Humanitarian activities. For Start24, we will consider SIGHT as an Affinity group within IEEE's MGA, a status that it does not have yet (if you consult the Web), but that matches the most its form of operation.

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The IEEE is a major publisher: having more than 3.5 million documents in its online Digital Library; publishing annually 170 transactions, journals and magazines; and overseeing 1,300 standards and projects under development. It sponsors over 1,300 conferences in 92 countries, attracting over 419,000 participants. Although the IEEE is entrenched in science and technology, its vision and core values aim to benefit humanity: IEEE's vision statement is: "Be essential to the global technical community and to technical professionals everywhere, and be universally recognized for the contributions of technology and of technical professionals in improving global conditions" [5]. Also defined is the importance of serving the public first and foremost while also serving its members.

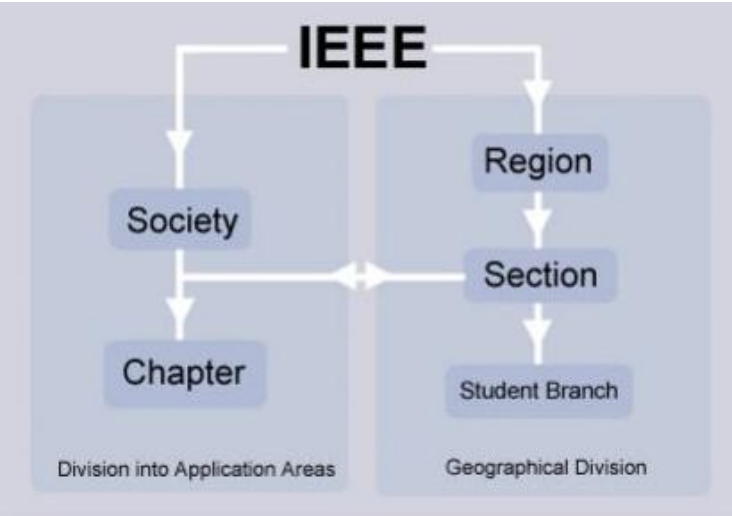

Figure 1: partial IEEE's organizational structure[3]

2.1 IEEE organizational structure

The IEEE is an international network of professionals with similar interests, and often stereotyped as logical, problem-solvers, opinionated, introverted and poor communicators; traits still perceived under the nuances of the many cultures in its ten geographic regions. Within these regions, members are associated with one the 333 sections which coordinate regular meetings and activities locally. To most members, these meetings are the primary means of participation; and the standards, publications and conferences are their usual means to leverage knowledge of technology to benefit human welfare.

[3] Refer to Annex A for a detailed IEEE Organization structure

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The IEEE is a not-for-profit volunteer-based organization: activities are almost exclusively organized and run by volunteers. Any money received in excess of expenses is deemed surplus for re-investing in, for example, programs and activities like those described above, including investing in its charitable foundations that provide, for example, student grants, scholarships, support for special projects like learning centres, and so on.

By choosing one or more of the 49 technical societies or councils, members gain access to technical material and insight plus focused opportunity to connect, communicate and collaborate with others. Many members participate in technical chapters at the section level, thus linking locally with others sharing similar technical interests and thus joining a network of over 2,231 local technical chapters. This complementary structure is governed by two boards: the Member and Geographic Activities (MGA), and the Technical Activities Board (TAB). Furthermore, other boards and standing committees complete the cast of organizations that form the IEEE, including: the Educational Activities Board (EAB); the Publication, Services and Products Board (PSPB); the Standards Association Board (IEEE-SA) [6].

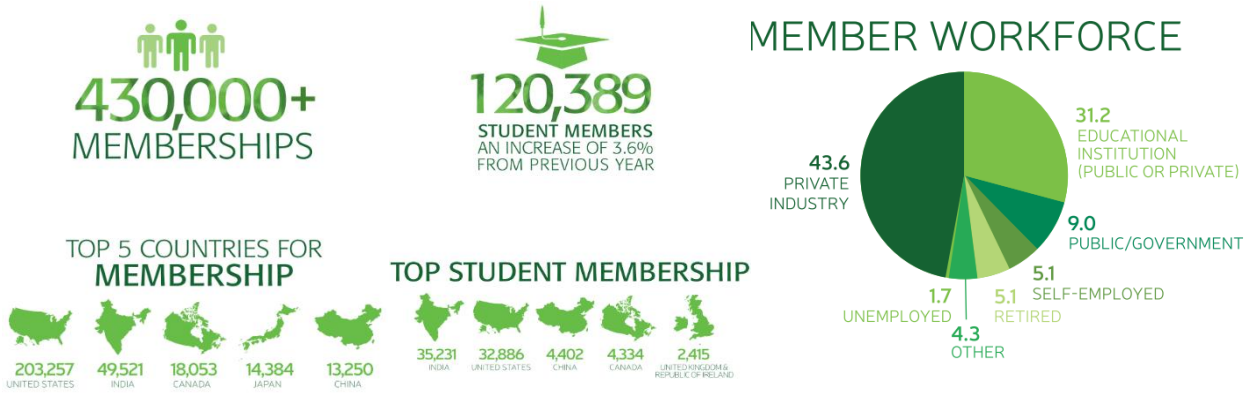

Figure 2: IEEE membership [7]

2.2 IEEE Finances and project funding

Most of IEEE funding comes from revenue generated from publication and conferences, and less so from membership fees. Sections receive funding from the IEEE MGA Board based on a scorecard for each member and society affiliates within the section, numbers of technical meetings conducted during the year, etc. IEEE is that of a tax-exempt not-for-profit organization registered in the United States, under Section 501(c)(3) of the US Internal Revenue Code; its organizational units may accept

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donations from foundations and government agencies under specific conditions; these policies enable for large collaborative projects.

The IEEE funds are reserved for public and member activities and services: the IEEE is not a charity; its Foundations are.

For 2013, the IEEE Statement of Activities reflects total revenues for 2013 of US$412.7 million, an increase of US$7.4 million, or 1.8% from 2012. Some of the key contributors that drove the increase in revenues are:

1. IEEE/IET Electronic Library (IEL)
2. IEEE All-Society Periodicals Package (ASPP)
3. IEEE Journals Archive revenue primarily due to 2013 being the first full year of this product offering

In 2013, IEEE had total operating expenses of US$425.1 million. This represents an increase from 2012 of US$16.7 million, or 4.1%. This increase is reflected both directly and indirectly in the many projects and initiatives that IEEE has undertaken, including:

1. Supporting the ongoing efforts of our technical communities, nurturing evolving technologies and cloud computing
2. Improving IEEE Xplore ® with an additional 600,000+ interactive HTML articles
3. Increasing efforts in Africa and India for the purpose of furthering engineering capacity

This resulted in an operating loss of US$12.4 million for 2013, which was in line with expectations; IEEE is also not intended to be a bank yet, must be prudent in spending. Included in the operating loss is a US$4.6 million charge for the net periodic benefit cost related to the IEEE Amended and Restated Employees Retirement Plans. IEEE employs staff to operate the day-to-day affairs of the association and help with “corporate knowledge retention” while the volunteers can run the organisation and in many cases still attend to work and personal affairs.

The IEEE Statement of Financial Position reflects total assets of US$557.8 million and US$470.5 million at 31 December 2013 and 2012, respectively. The increase of US$87.3 million was primarily attributable to the investment gains of US$55.0M and other net increases in working capital assets. IEEE total liabilities were US$229.2 million and US$197.0 million at 31 December 2013 and 2012, respectively. The increase of US$32.2 million was primarily due to deferred revenue (subscriptions, dues, and assessments) and amounts held on behalf of the IEEE Foundation. Overall, IEEE Net Assets increased US$55.1 million to US$328.7 million from the 2012 year-end balance of US$273.6 million. IEEE is tax exempt under Section 501(c)(3) of the Internal Revenue Code. The IEEE Foundation is the charitable arm of IEEE as a separately

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incorporated related organization of IEEE; accordingly, its audited financial statements are not included in the 2013 Annual Report [7].

Historically, the IEEE, apart from the Foundation, also provides grants for special projects in the range of a few hundred to tens of thousand dollars. Special projects, like the Humanitarian Technology Challenge (HTC) [8], or New Technical Activities, are funded by the New Initiatives Committee which supports potential new programs, products, or services that will provide significant benefit to IEEE members, the public, the technical community, and customers, or could have a lasting impact on the IEEE. Bottom line, the initiatives must be of strategic importance to IEEE. You find below in Table 1, the budget for the HTC where IEEE's New Initiatives committee provided most of the funding.

Table 1: HTC 2008-2010 Budget (Strat24 version)

HTC budget spent	**2008**	**2009**	**2010**	**Goal**
Travel, Conference calls	$150k	$190k	---	Preparation, Launch
Conference/Workshop	---	$200k	---	Event hosting
Project Management	$100k	$100k	$100k	Project & finance
Student Design Competition	---	---	$10k	Volunteer drive
Mobile Solar Rural Electrification	---	---	$110k	Franchise model
Rural/Hospital Data connectivity	---	---	$60k	Infrastructure, co-development
Small/Medium scale Solar charge controller	---	---	$40k	HW System & field trial
Total	**$250k**	**490**	**$320k**	
Budgeted	$1000k	$1000k	$1000k	

Numbers provided are notional and for the purposes of the 2014 Strat24 case competition

The HTC was a multi-year multi-million dollar pilot collaboration that was an exception to IEEE funding practices. It had relatively significant funding and human resources committed, but from a purely financial perspective the financial ROI was modest: completion of proof-of-concept phase for two HTC-solutions, field test technical results for one of them, a "Lessons Learned" report, and supplemental funding to continue the development of HTC solutions in 2010 and 2011. Unfortunately, the unintended fallout of the HTC was: a significant loss of committed volunteers and a failure to take a significant place in the development and relief sector.

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Relentless efforts of a few passionate members, with the support of the New Initiatives committee and a handful of sections, were able to consolidate the remains of the HTC initiative into a new program: the Special Interest Group on Humanitarian Technology (SIGHT). This group was funded for three years with a mandate to clearly show there is sufficient interest within the membership for a Humanitarian program, and that meaningful impact on humanitarian issues is possible. The SIGHT budget is represented in Table 2 below.

Table 2: SIGHT 2001-2014 Budget (Strat24 version)

SIGHT budget spent	2012	2013	2014	Goal
Program Management	$100k	$100k	$100k	Project & finance
Project Committee	$50k	$50k	$50k	Seed funding
Engagement Committee	---	$10k	$50k	Travel grants, workshops
Operations Committee	---	---	$25k	By-Laws, structure
Promotional items, webinars, travel	$25k	$40k	$25k	Publicity, member drive
Total	**$175k**	**200**	**$250k**	
Budgeted	$250k	$250k	$250k	

Numbers provided are notional and for the purposes of the 2014 Strat24 case competition

For major IEEE Humanitarian projects, it is strategically important to seek funding from NGOs, suppliers and known philanthropic/humanitarian funders; these partnerships are critical through implementation and deployment phases. The IEEE Foundation and its New Initiatives Committee (to a lesser degree the IEEE Canadian Foundation because of the smaller size) are internal sources of funding that seem to be most effective as seed money easing the process of obtaining "matching grants" or "in-kind" donations from other sources.

2.3 Humanitarian activities [9], [10]

In 2008 the IEEE launched a three year effort funded by the IEEE Foundation, the Vodafone Foundation, and the UN Foundation: the Humanitarian Technology Challenge (HTC). It was a very unique up-front, formalized collaboration between technologists (led by IEEE) and humanitarians (led by UN Foundation) to identify three challenges and drive solutions that were implementable and sustainable in the field, tailored to local socioeconomic conditions. The HTC had two goals [8]: (1) the creation of artefacts for specific humanitarian technological needs, and (2) development of a repeatable

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methodology for collaboration on technology-based humanitarian projects. The HTC relied on the altruistic and voluntary participation of technologists, humanitarians, non-profit organizations, students, and government employees.

By the way, an outcome of the HTC is also a few devoted members that created the Community Sustainability Initiative (CSI) that piloted a solar PV-battery portable power and charging cart micro-business after the Haiti earthquake that is now also being deployed in several other countries.

The IEEE has shown its commitment to establishing itself as a contributor of solutions to humanitarian problems. In 2011, the Board of Directors approved the consolidation of the stronger elements of the HTC initiative into the SIGHT program. SIGHT's mandate is to manage the creation of IEEE Humanitarian affinity groups, reporting to the Humanitarian Ad-Hoc Committee under the New Initiatives Committee. This unusual organizational structure testifies to the desire of investing time and effort in finding the most effective means to operationalize the IEEE Humanitarian program.

IEEE volunteers have been involved in a multitude of humanitarian activities during the duration of the HTC project and SIGHT program; with some IEEE activities outside of these programs. We note this so that Strat24 participants understand that IEEE does not prescribe nor control all activities: a lot of freedom is given to societies, sections and regions to set the scope of their activities; but organization-wide programs are better funded, have more resources dedicated to them, and can better withstand the sometimes annual churn of Organizational Unit (OU) officers and volunteers.

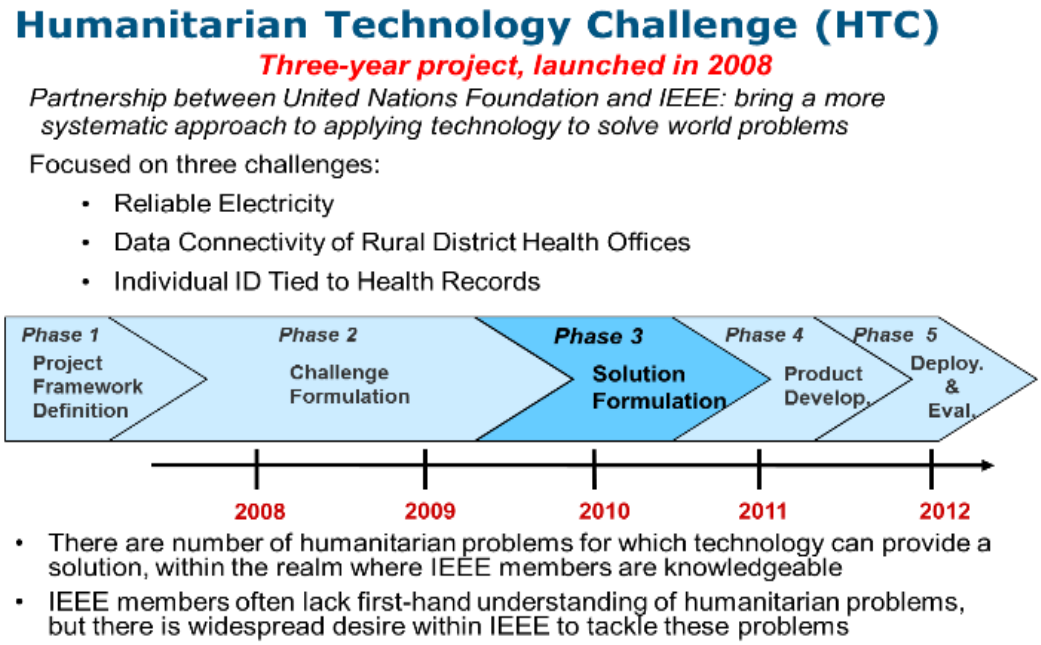

Figure 3: HTC timeline and general guidelines

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There are notable differences between HTC and SIGHT, as shown in Figure 4, below. The HTC framework was meant to enable the implementation of ideas and their hand-off to partners for deployment and maintenance. Within the HTC framework, a Humanitarian Technology (HT) "Solution" was defined as: a hardware/software product or process: that (a) meets agreed-upon standards; that (b) includes a corresponding Operations, Administration and Maintenance plan; and (dc) is driven by an Economic Implementation plan [10]. In a similar way, SIGHT's framework was meant to drive member participation; it has focused on creating opportunities for members to devote time and talents to humanitarian work by inviting them to create groups associated with an IEEE OU (i.e., Section, Student Chapter or Society) to work on activities that: inspire, enable or connect members. These activities, as intended, shall lead to a Humanitarian technology project.

Figure 4: HTC's and SIGHT's frameworks

The legacy of HTC and SIGHT activities is the production and sharing of knowledge: this is generally accepted as a way to increase the value of ideas and information; since their value will increase to the degree they can be shared with and used by others [11].

The more knowledge created by IEEE Humanitarian activities is diffused and adopted, the greater its value. But HTC and SIGHT have used different strategies: HTC's knowledge sharing strategy was to use on-line collaboration (crowd-sourcing), coupled with workshops. Results of HTC's volunteer work was always meant to be broadly available to anyone, a characteristic of free and open source technology. The knowledge created and shared by SIGHT, up to now, has been mostly administrative: how to get started, what activities are in scope, what are the sources of funding, etc.

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Since its original mandate (2012-2014), SIGHT has focused on capacity building: equipping new SIGHT chapters to:

- Inspire and be inspired
- Enable and learn
- Connect and collaborate within IEEE and with outside organizations
- Engage with the larger community of people interested in technology for development in-line with IEEE's vision to be universally recognized for the contributions of technology and of technical professionals in improving global conditions.

But given the renewed mandate, it is imperative to evaluate IEEE's capability to successfully establish itself in the Relief and Development sector. IEEE does not have the mandate nor capability to manufacture products or to provide broad-scale humanitarian services directly. To be successful, IEEE must assess its ability to manage access to the volunteers and any work of volunteers for their use in humanitarian products or services. It must identify knowledge gaps and devise a strategy to incubate self-sustained enterprises where free[4] and open technology is a key enabler, and knowledge re-use and adaptation is part of the process

At this time, it is imperative to evaluate IEEE's capability to successfully establish itself in the Relief and Development sector, to assess its organizational readiness to tackle humanitarian work, to identify knowledge gaps, and to develop a strategy that results in the continual incubation of self-sustained endeavours where free and open technology is a key enabler, and knowledge re-use and adaptation is part of that process.

2.4 Focus Areas

IEEE's desire to enter the Relief and Development sector seems like a predictable evolution of its vision to "be universally recognized for the contributions of technology and of technical professionals in improving global conditions" [5]; but it may as well be perceived as a stretch of that vision outside IEEE's core areas of activities. Historically, IEEE has measured its impact on the human condition by its technical contributions through publications, standards and enablement of member's achievements. But regardless of the point of view, it is obvious that the emergence of Humanitarianism[5] at the IEEE can be confirmed from the extent of the HTC and SIGHT initiatives.

[4] As Richard Stallman summarised it: "Think free as in free speech, not free beer". http://en.wikipedia.org/wiki/Gratis_versus_libre

[5] humanitarianism is an ethic of kindness, benevolence, and sympathy extended universally and impartially to all human beings. http://en.wikipedia.org/wiki/Humanitarianism

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Humanitarianism[6] has grown into a significant sector of economic activity. It has evolved from aid and relief work to global development programs; some agencies have even developed emergency response capacity. Before this change, there were only a few major relief agencies; relief work was not seen as a profession and those involved in it did not see this as their life's work. Emergency relief and human development are two expressions of humanitarianism. Emergency response focuses on providing assistance to save lives, alleviate suffering, or protect populations; while human development uses various societal levers to improve the living conditions of served populations, often along ideological boundaries: one notable example is the United Nation's Millennium Development Goals (MDG) programme[7]. IEEE's emergent humanitarianism can be traced back to the relief efforts of IEEE members in the wake of the 2004 Tsunami [13]; but its first planned IEEE Humanitarian initiative was the HTC [8]: a development effort.

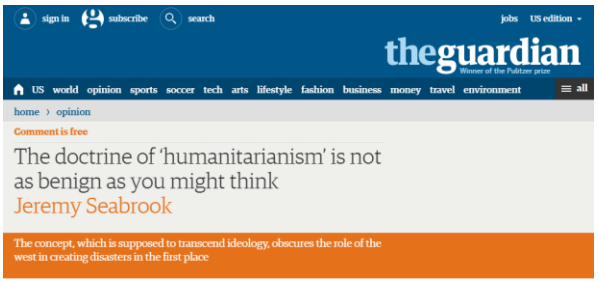

Figure 5: Article on the ideals and shortcomings of Humanitarianism

3.0 Technology-based human development

As humanitarianism has evolved over time, so has the technology used to get the work done. Today, Information and Communications Technologies (ICT), energy generation, irrigation technology, health diagnosis equipment, and computing are tools counted upon to effectively conduct humanitarian tasks. Technology-based human development can be described as the humanitarianism act that is only possible with the assistance of technology to alleviate the sufferings or improve the wellbeing of a chosen population[8].

One well documented example of human development is the UN Millennium Villages project9. The Millennium Villages Project (MVP) is a 10 year joint venture between the Earth Institute of Columbia University, the United Nations Development Programme (UNDP) and various partners to work with 14 sites in 10 countries under the direction of the United Nations governance in Sub-Saharan Africa.

For the initial five-year phase of the program, the MVP reported reaching nearly a half million, with each of the Millennium Villages having a $120 per capita ($480 million total) annual budgetary allocation [14]. Of this per capita budget, $110 directly supported

[6] http://www.theguardian.com/commentisfree/2014/sep/08/doctrine-humanitarianism-not-benign
[7] UN (Human) Development Program. http://hdr.undp.org/en/humandev
[8] Open Source Hardware for Human Development. Unpublished Masters thesis. Alfredo Herrera, University of Ottawa.
[9] Millennium Villages: A New Approach to Fighting Poverty. http://www.unmillenniumproject.org/mv/

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MVP interventions in agriculture, education, health, infrastructure, gender equality, and business development, and $10 was budgeted for establishing, training, and paying local staff to lead the village-based systems in each MVP site. The Soros Foundations Network contributed a five-year grant in the amount of $10 million per year for the first phase MVP budget:

Project scope and Funding: • Launched in June 2006, initially 5-year project, 2nd phase for '11-'15; • Covers ~ 500,000 rural people in 80 villages across 14 sites in 10 African • $480M/year • $120 per capita per year: $60 donor financed, $30 from local/national governments, $20 from partner organisations, $10 from villagers. • Budget allocation (suggested): 30% health; 20% infrastructure; 20% education; 15% agriculture and nutrition; 15% water, sanitation and environment.	***Outcomes:*** • Malaria prevalence decreased by 72% (from 25% to 7%) • Children sleeping under insecticide-treated mosquito nets increased by 629% (from 7% to 51%) • Households with access to improved water increased by 300% (from 17% to 68%) • Students benefitting from school meal programs increased by 188% (from 26% to 75%) • Births delivered by skilled health personnel increased by 55% (from 31% to 48%) • Across 6 sites, average maize yields increased from 1.3 t/ha to 4.6 t/ha
Goals and desired outcomes: • Health: decrease rates of HIV/AIDS, TB, and malaria, and improve maternal and child health • Infrastructure: Increase access to energy, transport and information & communications technology (ICT) • Education: Increase quality of education, and ensure universal primary education • Agriculture: Increase food production and incomes • Water, Sanitations &Environment: Increase access to safer water and adequate sanitation; Ensure environmental sustainability • Agriculture: Increase food production and incomes • Business development: Transition from subsistence farming to commercial agriculture to ensure sustainability of Project gains	***Partners:*** • Host Countries: Liberia, Cambodia, Jordan, Mozambique, Haiti, Cameroon and Benin • Open Society Foundations • The United Nations and Other Multilateral Partners • Hundreds of individuals, foundations, governments, institutions, and corporations

Table 3: Millenium Village Project (MVP) summary

The Millennium Villages Programme is a well-documented implementation of the Millennium Development Goals, and often serves as a reference in contemporary development, and a good source of technology-based human development: for

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example, its mobile connectivity project in partnership with Ericsson, MTN and Zain. This project started in 2007, and by the end of 2009 83% of the focus villages had mobile communication capabilities. The results from this project part of the project show that the introduction of mobile networks has the potential to influence human development in remote villages by an average of 1.2% growth in GDP for every 10% increase in mobile penetration rate. In the health sector, mobile phones represent an unprecedented opportunity to respond to emergencies, create a cadre of well trained and accountable health workers, and reduce isolation for those who work in rural areas. This finding is particularly relevant in the context of Sub-Saharan Africa, where health care delivery is limited by availability of resources, large distances and poor infrastructure. Mobile phones are used for consultations, to provide better service at the point-of-care and in making and following-up with referrals. Improved competence and efficiency of health institution has further benefited the local inhabitants through improved quality of care offered. Moreover, lives of people can now be saved, as health workers are able to respond to emergency situations, signaled through mobile technology. The use of mHealth applications has the potential for reducing processing time for data collection and analysis, from weeks to a few minutes. Refer to Appendix D for details.

3.1 The IEEE Humanitarian Technology Challenge [15]

The HTC was IEEE's first deliberate humanitarian project unlike the emergency response of the Kerala section volunteers after the 2004 Tsunami [16] - A disaster that devastated the whole of the Indian Ocean region, from South East Asia to South Asia to Africa; killing over 100,000 people.

The Kerala Section members stepped in for rescue/relief work after the first two (2) days, providing help in communications, logistics, planning and co-ordination (no other IEEE Section was directly involved in any country).

Cleon Anderson, the then IEEE President visited Kerala on Jan. 2005, when the Section volunteers asked IEEE to have a stronger humanitarian program. The response of the Kerala section to the 2004 Tsunami helped sensitize the IEEE leadership on the need to use and develop technology for humanitarian considerations; which some believe was influential in bringing the Humanitarian Technology Challenge to life. The Kerala section has since been involved in a constant flow of humanitarian activities. This again is unique in the fact that it is a grass roots initiative and not a result of an IEEE global program.

Some of the Kerala section activities include: Free and Open Source software stack and computing for the visually impaired, off-grid power supply, community mapping for Disaster Risk Reduction, remote surveillance for natural disasters. Kerala's humanitarian activities span different iterations of IEEE humanitarian initiatives.

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One of these iterations was the HTC, which took place between 2008 and 2011. It was a focused collaboration with NGOs, and all IEEE OUs, and it was a great learning experience for the various levels of IEEE (staff, TAB, MGA, sections, members). During its run, IEEE:

- Worked with 15 NGOs and Foundations in four focus groups to research needs
- Identified 37 needs, from where three were selected: Individual Patient ID, Data Connectivity, and Reliable Electricity
- Had 22 Societies represented on Society Partnership Group
- Had all 10 Regions represented on Regional Partnership Group
- Had 35 external strategic partners for field tests
- By end of year, solution tests underway in 10 countries
- Got over 1000 volunteers involved
- Used over $3M in funding over four years, including funding from: NIC/Board, UN Foundation, IEEE Foundation, NPSS, PES

For details on the Challenges, the solution research methodology and framework used: refer to Appendix C.

3.2 SIGHT

As we have discussed, IEEE has placed great emphasis on technology-based humanitarian initiatives, instituting the Humanitarian Ad Hoc Committee (HAHC) in 2011, as part of a strategic effort toward member engagement, HAHC oversees the SIGHT programme SIGHT strives to promote activities which use appropriate and sustainable technologies to benefit the vulnerable and underserved sections of humanity. It operates as an Affinity Group and had an initial mandate of three years to focuses on creating opportunities for members to devote time and talents to humanitarian. Six IEEE members can create a SIGHT chapter, but they are required to be associated with an IEEE OU (Section, Society, Student Chapter) to work on three types of activity: that Inspire, that Enable, that Connect. SIGHT activities shall lead to a technology-based humanitarian project. SIGHT's mandate was reaffirmed in November 2014 by the Board of Directors, with a renewed vision:

> "to be a sustained contributor to solving global humanitarian issues through the application of technology. This is in-line with IEEE's core purpose *to foster technological innovation and excellence for the benefit of humanity*".

SIGHT's focus on activities that shall lead to a project is unique to this programme within IEEE. Usually, chapters/committees are asked to hold regular meetings on topics under the scope of that chapter/affinity. Where SIGHTs are asked to devise and run a project. These projects shall support sustainable humanitarian technologies with measureable impact in alleviating poverty or lack of access to: energy, health care, sanitation, communication and similar technologies for vulnerable and underprivileged communities. It is highly recommended that SIGHTs adopt the IDE project framework: A

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framework for the long range goals of SIGHT, emanating to large degree out of the pioneering work of Paul Polak, a practitioner for three decades in sustainable development and author of “Out of Poverty”, IDE is an acronym for Incubate, Demonstrate, Educate - three nested practices that sustain socially equitable, economically prosperous, and environmentally sound community enterprise.

IDE Goals Defined – *Courtesy D. Wessner*

Incubate	*Demonstrate*	*Educate*
Capacity building with *Engineers*	Capacity building with *Local Entrepreneurs*	Capacity building with *Community Leaders*
Metrics: IEEE-wide involvement, support, project-NGO groups	Metrics: Sales, profits, repeat customers, demonstrated sustainable	Metrics: Community men, women, children understand, engaged in process of change
Products: Reliable electricity, medical, web interconnectivity, agricultural water, & storage , refrigeration	Products: Sustainable, radically affordable technology services, economic impact on community, nationally	Products: Elementary Secondary, business advanced modules, technology, affordable degree track programs
Agents: CSI, IEEE, partners	Agents: NGOs, for-profit offspring, venture funds	Agents: Universities, IEEE, EWB
Professional Non-Profit, Pro Bono volunteers	Non & For-Profit NGO partners, local & national	Non-Profit INGOs, Universities

SIGHT Project Guidelines & Standard Model
6/23/2013 R. Larsen 5

Table 4: SIGHT's IDE goals for technology-based humanitarian projects

SIGHT programme has grown to account for 54 SIGHTs in 2 years, this is as large as 50% of IEEE Societies. SIGHT has funded about 50% of the project proposals it has received.

SIGHT group	Funded project	Ammount
SIGHT Chile	Interactive Classroom	$14, 945
Drexel SIGHT (US)	Teaching with Tablets	$4,450
CARG SIGHT Bangladesh	Electrically assisted rickshaws	$5,975
RAS SIGHT	HRATC'14 prize sponsorship	$2,000
Kerala Section (India)	All Kerala SIGHT Camp	$1,200
SIGHT PUC MINAS (Brazil)	Promoting Humanitarian Technology in the Maria Teixeira School	$3,310
IEEE-Montréal-SIGHT	Open-Source Avalanche Rescue Imaging	$850
Ottawa SIGHT	Open Source Avalanche Radar Imaging System	$1,500
Bangalore SIGHT	AIYEHUM	$4,000

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4.0 MANDATE

Given all information available to you in this document, consider the IEEE humanitarian example Appendix E (pp. 23-40): and do the following:

I. How well does the example in Appendix E fit the stages shown in Fig 4. Does this project indicate that insight is an improvement on HTC?

II. How well does the example in Appendix E deal (or fail to deal with) with the 5 major areas given on pages 1,2:

   a. Operations,
   b. Branding,
   c. Management,
   d. IEEE Membership and
   e. Evaluation

III. In your teams opinion, given your understanding of IEEE based on the information in this document: Is IEEE's current SIGHT strategy favourable to incubate self-sustained technology-based humanitarian

IV. Finally, for a 10% bonus: what would be your teams strategy for building public and member awareness of IEEE's Humanitarian initiatives and encourage contribution of talent, time, or project funding

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5.0 REFERENCES

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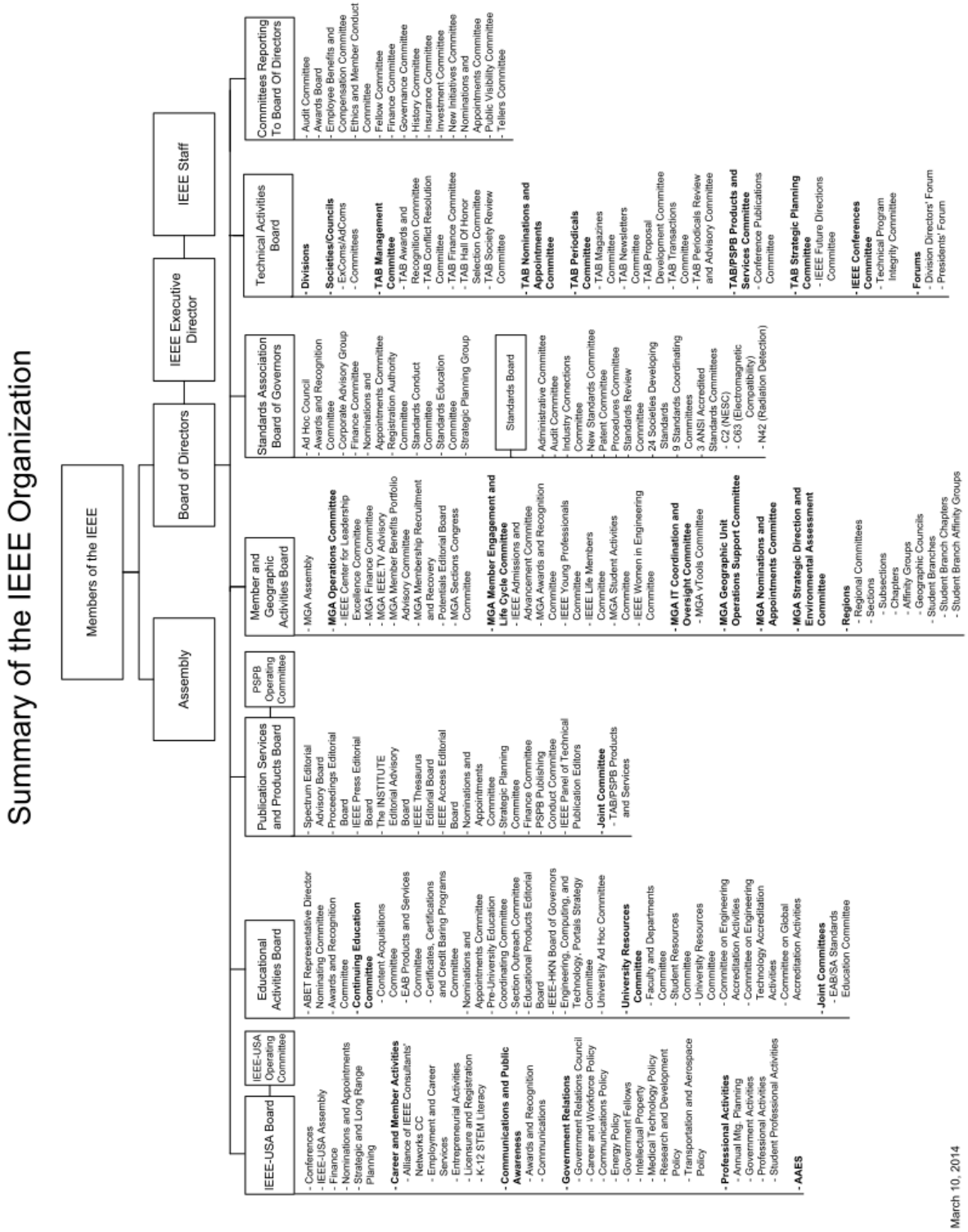
Appendix A

Chart containing a Summary of the IEEE Organization (PDF, 15.8 KB)



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Appendix B

You can find the annual IEEE reports here:

IEEE 2013 Annual Report:

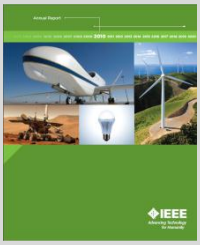
http://www.ieee.org/about/corporate/ieee_2013_annual_report_final

IEEE 2012 Annual Report:

http://www.ieee.org/about/ieee_2012_annual_report.pdf

IEEE 2011 Annual Report:

http://www.ieee.org/about/corporate/ieee_2011_annual_report.pdf



IEEE 2010 Annual Report:

http://www.ieee.org/documents/ieee_annual_report_10_1.pdf

IEEE 2009 Annual Report:

http://www.ieee.org/documents/ieee_annual_report_09_complete.pdf

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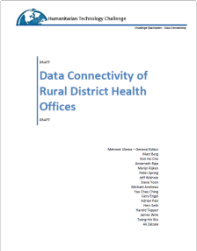
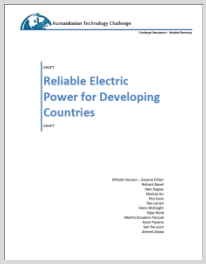
Appendix C

You may want to refer to these IEEE Humanitarian Technology documents (2009):



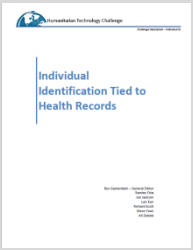
IEEE 2009 Data Connectivity Humanitarian Challenge:

http://oc.ieee.org/usercontent/1/3/338070001/42/0_Data_Connectivity_Challenge_Description.pdf



IEEE 2009 Reliable Electricity Humanitarian Challenge:

http://oc.ieee.org/usercontent/1/3/338070001/44/0_Reliable_Electricity_Challenge_Description.pdf

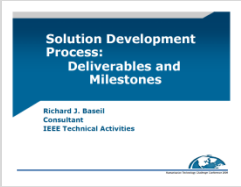


IEEE 2009 Personal ID and Health Record Humanitarian Challenge:

http://oc.ieee.org/usercontent/1/3/338070001/85/Individual_ID_Challenge_Description.pdf

IEEE 2009 Humanitarian Challenge Secondary Research Tip Sheet:

http://oc.ieee.org/usercontent/1/3/338070001/89/8d_Secondary_Research_Tip_Sheet.pdf



IEEE 2009 Humanitarian Challenge Solution Development Process:

http://oc.ieee.org/usercontent/1/3/338070001/79/7_Baseil.pdf

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Appendix D

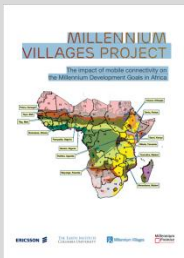
You may want to refer to these technology-based humanitarian project documents:

Project Briefing – Sustaining and scaling up Millennium Villages (Oct. 2008):

http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/3007.pdf

The Millennium Villages Project, The Next Five Years 2011-2015:

http://www.millenniumvillages.org/uploads/ReportPaper/MVP_Next5yrs_2011.pdf



Millennium Villages Project, The impact of mobile connectivity on the Millennium Development Goals in Africa:

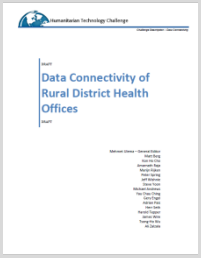
http://www.ericsson.com/res/thecompany/docs/corporate-responsibility/2010/MVP_M_&_E_Final_Report_August_31_2010.pdf

HTC- Data Connectivity: Experiences in volunteer dynamics (2011)

Murillo, M.J.; Wright, D., "Experiences in Volunteer Dynamics, Inter-organizational Collaboration and Leadership for the Purpose of Deploying Telemedicine Solutions in Remote Areas in Developing Nations," Global Humanitarian Technology Conference (GHTC), 2011 IEEE , vol., no., pp.301,310, Oct. 30 2011-Nov. 1 2011
http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6103654&isnumber=6103596

HTC-Data Connectivity Remote Health Offices, Sections Congress '11

http://www.ieee.org/documents/serve_humanitarian_murillo.pdf



IEEE 2009 Data Connectivity Humanitarian Challenge:

http://oc.ieee.org/usercontent/1/3/338070001/42/0_Data_Connectivity_Challenge_Description.pdf

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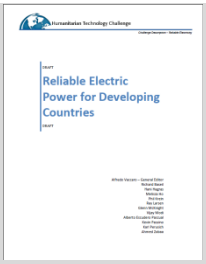
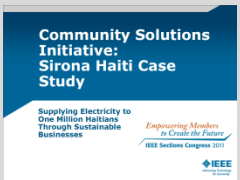


IEEE 2009 Reliable Electricity Humanitarian Challenge:

http://oc.ieee.org/usercontent/1/3/338070001/44/0_Reliable_Electricity_Challenge_Description.pdf



HTC-Reliable Electricity: Sirona-Haiti, Sections Congress'11

http://www.ieee.org/documents/serve_humanitarian_lacourciere

HTC-Reliable Electricity: Learning beyond the light bulb

Larsen, R.S.; Welbourn, D.; Wessner, D.; Podmore, R.; Lacourciere, M.; Larsen, A.; Lee, P.; Moulton, R.; Myers, S.; Niboh, M.; Ryan, P.; Wilson, M., "'Learning beyond the Light Bulb" among Least Developed Countries based on a sustainable PV solar utility model," Global Humanitarian Technology Conference (GHTC), 2014 IEEE , vol., no., pp.106,114, 10-13 Oct. 2014
http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6970268&isnumber=6970242

SIGHT Project Guidelines (lessons learned from HTC)

http://www.ieee.org/about/corporate/initiatives/guidelines_for_submittal_of_sight_projects.pdf

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Appendix E

Case study example made available with permission from co-author:

From partnerships and implementation to sustainability of long-distance telecommunication initiatives in extremely remote and poor areas of the world

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Abstract

The present paper provides recommendations for the planning, socialization, implementation and socio-economic sustainability of long-distance data connectivity projects in very poor remote areas of the world not served by commercial telecommunications institutions. The recommendations are based on pragmatic experience from an ongoing initiative that started in 2010. We focus on the application of a framework that focuses on socializing the target citizenship and leadership to form a stable basis for the implementation, utilization and sustainability of long-range Information Communications Technologies as tools for the reduction of the digital divide and the improvement of health and social conditions. The multiple-component approach also provides a framework for the expansion of infrastructure and services based on a sustainability plan adapted to current contexts.

1. Background

1.1. The importance of digital telecommunications

New means of transportation, production and telecommunications technologies have had enormous impacts on the economic, political, and social aspects of nations and their people. Different disciplines argue on whether the overall consequences of these advances have been all positive or negative for humanity [1]. For instance, there's little doubt that the industrial revolution is one of the main causes of global warming. Digital technologies are not except of such complex mix of positive and negative repercussions. While the impacts of digital technologies are gradually extending into health, education, governance, and human rights [2], these technologies are being adopted at alarmingly different rates and levels around the world and within countries themselves, thus impacting the levels of development and empowerment of individuals, groups of people, and nations themselves [3, 4]. In some cases, technologies that are often labelled as "democratic" and should be tools to reach and impact all citizens are technologies that are unevenly empowering segments of the population, thus altering the political, social, health, and economical ecosystems in favour of selected few.

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1.2. The status of data connectivity in the world

The basic condition for the existence of the Internet is the availability of wired or wireless communication infrastructure, also called “physical layer.” While advances such as the Internet of Things, HD streaming, and other technologies are at their height in some societies, great portions of the world will not have access to even slow Internet in tens of years to come. It will need to pass even more years until these populations enjoy current technologies that we in parts of the western world have it for granted.

Indeed, overall, only 25% of developing nation population utilizes the Internet. Fixed broadband penetration remains low in some regions such as Africa and the Arab States, with 0.2% and 2% respectively [6]. According the ITU, by end 2011, Africa’s Internet penetration rate was only 15.6%; it is expected that by 2020, this figure will raise to 25%. While current macro indicators in South America and Middle East seem more optimistic (48.2% and 40.4%), they all must be taken with caution as these hide the harsher reality of rural areas and very poor nations, some of which are composed on it majority of rural area population. These figures also hide the reality of very low speeds and low quality of service given to urban populations which is inadequate for tasks that most of the western world have had for tens of years. These realities has led to the utilization of appropriate mechanisms for "Internet" provision. For instance, the internet in rural Africa is entirely different to the internet used in the developed world; in parts of this continent, hundreds of millions of people will experience the internet for the first time on a 2-inch cell phone screen, in black and white, and probably only as text [7].

Other challenges abound, including inappropriate government national policies. In India, for instance, appropriate regulation has led to prepaid mobile telephony costs of 0.01 USD per minute, one of the cheapest in the world. Peru’s cost per minute in remote areas, on the other hand, is twenty times higher. These diverging realities let the citizenry and institutions face different sustainability challenges, particularly when most of the rural areas experience low people density, inhabitants live with under a dollar a day, and face other challenges such as illnesses, malnutrition and high child and maternal mortality rate.

In spite of ambitious national development plans and ambitious goals set by international organizations such as the ITU, the prospects of remote areas to enjoy moderate connectivity is still tens of years away [9]. Governments and international organizations are trying to understand and better the prospects, however the lack of appropriate national policies, the lack of international concerted and coordinated efforts, and the limited and isolated interventions have only limited impact. Good willing international short-lived interventions have also generally failed due to the paternalistic nature of projects, the lack of long-term sustainability plans, the short-life nature of projects, and the lack of understanding of local contexts such as culture, language, politics, policy, and religious beliefs [8].

In the mainstream communications sphere, commercial telecommunications companies' business models generally prefer areas of high citizen density that favor adequate revenue from services. State-sponsored initiatives also prefer areas of higher density in order to have impacts on wider sets of the population and justify spending. Similarly, emerging initiatives that profit from customer data and ecommerce also prefer more populated areas for the same reasons above. Sparsely populated remote areas are not attractive to the application of these business models and thus left untouched or to the mercy of well-meaning organizations for years to come.

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1.3. Data connectivity and health

Technology has a vital role in the health betterment of individuals. The role of technology as a tool has been so pivotal that it can be at times impossible to make a simple surgical procedure without its assistance. Very poor rural areas in developing nations would also welcome advanced technology for the betterment of health; however, in these areas, low life expectancy is generally due to easily preventable and treatable diseases such as diarrhoea, Chagas disease, dengue, complications of malnutrition, birth complications, and others. In these cases, tools such as basic communication technologies would help enormously through enabling interaction among professionals, remote consultation and diagnosis, information on medical supplies, sharing of patient records, second opinions, evacuation information, and health education. Indeed, leading world humanitarians have identified data communications for remote health offices as one of the top three tools that will contribute to the fulfillment of the Millennium Development Goals (MDGs) [10].

1.4. Purpose of the paper

This paper draws experience gained from an ongoing initiative (that started in 2010) in a very remote area in the Peruvian Amazon, one of the poorest areas in Latin America and the world. The initiative consists in the implementation of telecommunications infrastructure and the transport of data (audio, video, files, Internet) among four points, tens of kilometres away from each other. We provide recommendations for the implementation of similar long-distance data connectivity initiatives, putting emphasis on the social aspect of these initiatives and the creation of local capacity and entrepreneurship. The paper fills up gaps left by excellent technical literature, the availability of good studies and indicators, and the availability of affordable long-distance technology [14,17,18].

In contrast to the utilization of satellite services for long-distance communication, the approach utilizes inexpensive microwave devices and tower infrastructure that remain as assets for tens of years to come and can be utilized for other services for sustainability purposes. The recommendations can be important given that similar situations are found in various parts of the world, experiencing minimal prospects of being served by national or private telecommunication institutions in the years to come. Similarly, in some cases, these experiences might be relevant when foreign interventions are limited due to national policies that are restrictive when personal privacy or national security are at stake.

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2. Peruvian Amazon initiative background

The Peruvian Amazon initiative[i] started with the worldwide search of potential partner organizations with a good track record and experience in socially focused long-haul connectivity projects, rural health, aspects of sustainability beyond the funding period, and a high degree of direct and efficient involvement in rural development. This involvement needed to be at the implementation and operation stages, taking into consideration issues such as culture, local issues, and politics. The target areas identified for an intervention are inhabited by multi-ethnic population, including native tribes. They all partake of natural resources, daily life, political issues, and general challenges, such as high maternal mortality rate, life below the poverty line, bad disease and mortality indicators, and consequences of climate change. Flooding, lack of electricity, lack of potable water, unreliability of river trips, high costs of staples, and inability to export produce are factors that complicate the context. Other issues that have further complicated the situation are their isolation for hundreds of years, extreme remoteness, and the challenges that remains as a result of the operation of terrorist groups, which had operated in the region for a period of 30 years. The lack of other sources of income such as tourism and

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export of produce provides high levels of uncertainty for the future. None of the areas enjoyed any type of digital communication at the time.

Figure 1. The health posts and health centers of three remote rural villages and one town were linked with each other through high-speed digital data communication links. Line of sight distance from one point to the other ranges between 25 and 40 Km.

Two of the poorest remote villages in the area are Balsapuerto and Varadero, inhabited by approximately 1.500 people each, including adjacent areas. See Figure 1. Each village has a health centre served by an inexperienced doctor and supporting health personnel. San Juan is a 500-inhabitant village served by a medical technician. Balsapuerto and Varadero are strategic for the region and nearby villages and reachable only by boat from Yurimaguas, which is the nearest town with a hospital, telephony, and Internet service. Balsapuerto is located at 113Km boat trip from Yurimaguas. Boat-trip to Varadero can take up to two days, and to Balsapuerto more than 3, when river levels are low. Travel and patient evacuation is practically impossible when rivers are below certain levels or during rainy season when electrical storms make it dangerous to traverse the rivers. Such transportation problems have complicated the evacuation of sick villagers and resulted in many preventable deaths. While there is a proposal to construct a road in the coming years, such is uncertain due to the overly high cost of building roads over swamps and unstable land; opposition to those roads for fear of deforestation has also been an important issue.

3. Partnership and Collaboration in the Peruvian Amazon Initiative

The multi-stakeholder composition and the multidisciplinary nature of these interventions -- that seek to better human conditions and empower all stakeholders -- require appropriate frameworks and partnerships that ensure the success and effectiveness of such interventions. Figure 2 illustrates the relationship of all stakeholders that are taking part in the Peruvian Amazon initiative for the last five years. The core of the initiative has been partnership and collaboration at different levels. Such enabled self-sustainability beyond the implementation phase, expansion of infrastructure and services, and replication and transfer of knowledge and

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know-how to other similar projects in other parts of the world. A similar distribution of stakeholders can be expected in projects in other regions.

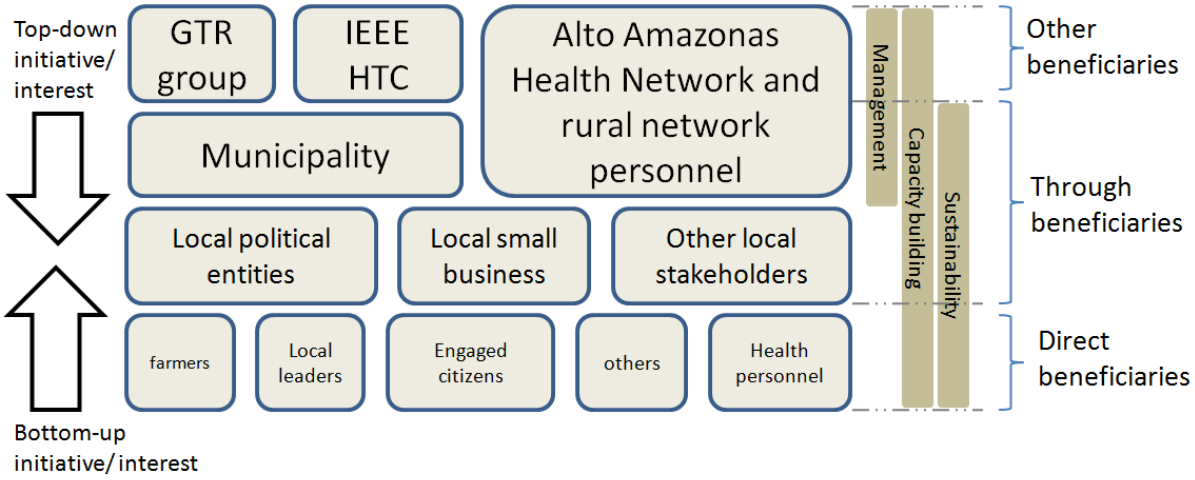

Figure 2. General depiction of Amazon project stakeholders

3.1. Top-down and bottom-up socialization

The Alto Amazonas Health Network's leadership along their rural health personnel have been the most important stakeholders, properly socialized by the main partner[ii] (GTR Group). See Figure 2. The former is led by leadership and personnel very well aware of the local health challenges; they are also aware of how technology can contribute in improving such challenges. In this context, we define "*top-down socialization*" as the process of making high level regional political and health authorities aware of the following: (i) the benefits that appropriate (i.e. sufficient bandwidth) telecommunications will bring to their communities in the short, medium and long range; (ii) the importance of taking active part in the implementation and sustainability of the project, economically, through their personnel, or through other means; and (iii) the possible benefits that such projects will bring to them, including possible positive professional and political benefits. The informal allusion of these possible benefits has shown to be an important instrument that can help in the ownership of the initiative, thus having important implications on the sustainability and overall success or failure of the initiative.

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Figure 3. Volunteer in interaction with locals and their social organization at the pre-implementation (bottom-up socialization) stage.

Figure 4. Utilizing the newly deployed telemedicine services in the village of Balsapuerto

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Similarly, we define "*Bottom-up Socialization*" as the process of making local citizens and grass-roots organization aware of the same issues above. These socializations are generally initiated by the main local partner and in some cases by the funding organization. The initiative is characterized by a gradual bottom-up socialization, seeking the acceptance and trust of the locals, especially in areas that enjoy local political autonomy and that have a history of rejecting social interventions that in principle seek to better their conditions. It is important to underline that such rejection of initiatives could be due to their earlier negative experiences in issues of sustainability, failed initiatives, unfulfilled promises of well meaning organizations, and other related issues. Important stakeholders involved in this socialization are local population, local indigenous leadership, the main partner organization, and key members of the Health Network. Local health centre personnel, having generally very good relationships with locals, facilitated direct communication with them. This resulted in important contributions such as the donation of land for the installation of infrastructure and the subsequent involvement of the residents in the implementation and sustenance work. Another important result of appropriate socialization is the respect that locals will have to the infrastructure and services; this will extend not only to the proactive basic maintenance of the infrastructure but also to the lessening of chances that the equipment will be stolen or damaged.

3.2. The importance of the high community cohesion

An important characteristic of the Alto Amazonas region is that its citizenry can be quite involved in the day-to-day happenings of the community through a variety of political and non-political institutions. In part because of the isolation of these areas and the challenges their citizens face, there's generally a high degree of community building which gives them a strong voice before the higher political authorities. For example, they take part in non-political groups of residents that watch for the wellbeing of their community. These institutions have different lifetime cycles than political institutions. Thus their support is very important as they could determine the project's continuity, particularly when there's a transition in the more political institutions such as the Health Network or the municipality. It is important to note that these types of social cohesions have been proven to be very desirable, particularly when evaluating vulnerability of these regions to climate change and other challenges that could have devastating effects in the community [20].

In spite of these organizations, there exists tensions between authorities and local religious leaders, who can exert considerable influence on the population, particularly because religious

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background and superstitions. For instance, there exists “competition” between the doctors or nurses in health centres and the religious leaders (or “witches”); the latter promise to heal diseases through processes that conform more to the cultural and religious norms of the locals. Native individuals can trust more on their religious leaders when they are sick and seek healing. When such healing methods do not work, they are finally referred to the health centres, where a sick person might pass away because his disease might have advanced to critical levels. To counteract this tension, health centers and posts have adopted various cultural and religious aspects and incorporated them into the operation of some of these processes, as it is the case of the birth process.

4. General sustainability plan

The aforementioned socializations and work have resulted into a collaborative implementation and joint operation and maintenance, thus assuring the short-term self-sustenance of the project. However, political changes and other factors call for a diversification of stakeholders and the expansion of services into other areas of the region, including the provision of services other than health.

There’s no magic bullet for the ongoing success and constant operation of the infrastructure in these remote areas, especially when they are highly dependent on a mix of high-level political and economic components that are extremely time-varying or volatile. These issues might underline the need for more socially oriented innovative sustainability models that will involve more the local population, will diversify the source of income, invest any benefit in the community itself, and will focus on pressing issues. This section provides a general glimpse of the sustainability plan of the Peruvian Amazon initiative.

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Figure 5. Gathering of local, regional leadership, and other institutions with the goals of further the business model.

Figure 6. Upper portion of a 60 meter telecom grade tower located in the Varadero health center. Each point is self-sustaining working 24/7 utilizing solar energy and low power high-bandwidth (60 Mbps) equipment.

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In our context, a business (sustainability) plan needs to evolve and adapt itself to the time-varying realities of the circumstances of the region. The plan makes explicit the short, medium and long-term prospects based on actual needs. The plan needs to include innovation, capacity-building and empowerment as key components, as recommended by researchers, practitioners, and the beneficiaries.

The socialization of the project, which was the basis for implementation, short-time sustainability and service to health, will be part of other components that form the basis for the long-term sustainability and further diversification of services. Other important factors that will influence the long-term sustainability are the momentum resulting from the short and medium-term success of the initiative, the benefits that the network is providing to the community, and the responsibility to serve to other high-need applications such as education.

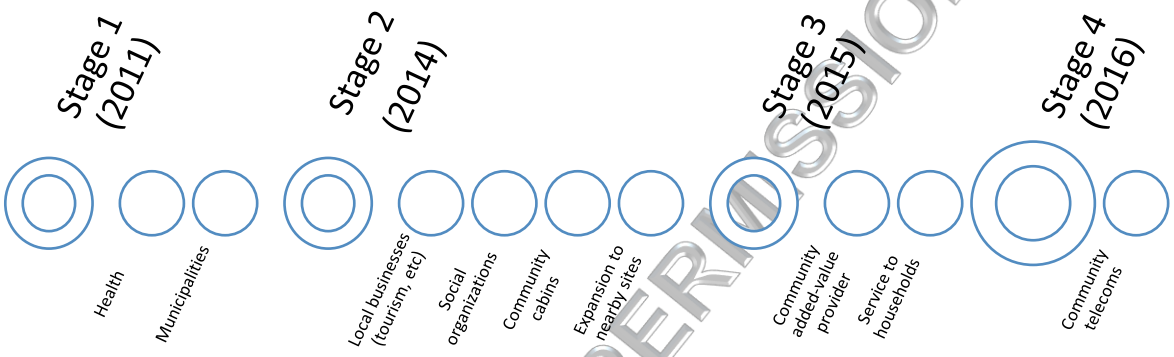

Figure 7. Stages in the expansion of the services provided by the network.

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Figure 7 illustrates the stages of a medium and long-term sustainability plan whose different stages are being planned and implemented. The plan is composed of periods that last various years. Each period is characterized by gradually and securely expanding the infrastructure and services, thus incrementing the utilization of the network. The first stage has been in operation for almost three years and it is focused mostly to health. We argue that health constitutes a good foundation and pillar for further expansion to other areas because of the following reasons:

1. The area of health has an urgent need of communications and is generally prioritized by governments
2. Health workers in remote areas have generally a good trust relationship with the local population. In the case of Peru, health is not free and has a small cost, thus the system is not over paternalistic.
3. Health centres and health posts are generally available at all times in remote locations
4. Political changes might have only a small effect in the health area. Resident doctors or nurses are quite stable, at least for the period of their field work
5. The utilization of ICTs for the saving of lives and other health-related positive results have generally high visibility and are appreciated by the local people and national organizations
6. Generally governments put reasonable amounts for funding for health in national budgets
7. Health posts and health centres know the importance of communication; in some cases, they already utilize VHF communications; this implies that there's already allocation for communications in their budget
8. Infrastructure destined for health care can be generally more respected and there's less probability of it being stolen

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9. While the health area is the one that has the most rotations in rural areas, this also provides local champions who have a high level of education and could be important stakeholders in taking charge of the infrastructure and training locals
10. As the infrastructure gets gradually adopted, its benefits are correspondingly felt and a certain level of dependency is created. Thus the leadership gradually includes different aspects of its operation in the yearly budget.

The second stage consists in providing services to education, local businesses, social organizations, and create community cabins in each village. The last two stages are characterized by serving as a community operator. Governments (as it is case Peru) provide rural community licenses to institutions that comply with a series of legal and technical requirements. It is only then that the institution can operate as a mobile rural operator. These requirements and responsibilities set the "rural telecom" (i.e. rural operator) stage as the last stage in the business plan. In the meantime, and in order to gradually deploy infrastructure to the citizenry, the entity will serve as a "added-value provider", whose requirements are considerable less than for "rural operator". A combination of two institutions, a non-profit private entity and a cooperative whose members are "owners" of the infrastructure is the modality that facilitates the legal provision of services.

In this context, the non-profit enterprise is composed of an entrepreneur whose center of operations is in Yurimaguas and is in charge of lending technical services to the cooperative. An incubation entity serves the cooperative and the non-profit private institution. Operating capital will flow depending on the period; initially it will come from cooperative membership fees, grants, and income from health and education budgets destined to telecommunications. The entrepreneur has ties with the local communities or the area, thus bettering probabilities of him not leaving the area in search of better prospects once he is trained.

Technically, the network resembles a regional area network. For local and regional voice communications, which accounts for over 50% of traffic, it keeps the traffic local (i.e. maintains VoIP communications local without resourcing to an external network). Otherwise, VoIP traffic is routed through the Internet. The different points in the villages are served through low-cost mesh networks. Internet traffic is freely given to all members of the cooperative.

Important characteristics of the Peruvian Amazon initiative that are influencing the business plan are:

- Towers for backhaul are situated in the premises or health centres or in nearby land donated by the local community
- Implementation funding was given as a grant or donation; local and foreign volunteers helped through the implementation and socialization
- For over two years, the infrastructure has serviced mostly health centres and the municipality; funding for maintenance came from the Health Network
- Expertise in tower building and other areas are readily found in Yurimaguas; minimal technical expertise can be found in Balsapuerto and Varadero
- Balsapuerto is known to attract tourism, particularly related to archaeology. Locals are in the process of creating community tourism and ecotourism
- Balsapuerto has a high school and serves as the host of the Balsapuerto Municipality, which until recently was located in Yurimaguas.
- The reality in Varadero is different. The village is important because it is a strategic hub between Yurimaguas and Balsapuerto, including other villages in the region.
- Yurimaguas has seen noticeable increase in economic activity. High-speed Internet connectivity is available in the city.

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- San Juan is a strategic small village 27 Km from Yurimaguas that can be accessible by car except at times during rainy season.

5. Recommendations

In the light of our mixed (positive and negative) experience we have had in the last five years, we furnish recommendations that underline important issues to consider in the conception of socially focused telecommunications interventions in areas that are not attractive to telecoms and that present social, economic and health challenges. While the recommendations are focused to microwave tower-based infrastructure for long-distance communication, it can be applied to other technologies and deployments, satellite communications and local or regional mesh networks being some of them.

5.1. Partnership

While the first challenge is the (funding entity's) clear definition of short, medium, and long term objectives, the second challenge is the identification of a local partner organization that focuses on similar goals and objectives. Project calls, public announcements and the use of already widely known expert partner organizations may seem appealing; however it is encouraged to invest time in the search of other potential partners, many of which are well qualified but lack the know-how of writing proposals, formal documentation, or do not speak the language of the funding organization. Concrete implementation examples will speak more than well elaborated proposals or flashy presentation brochures.

With such as a basis, there are important aspects that we consider desirable in an organization for having an effective, responsible, and long-term success in the intervention. On the technical side, it is desirable that a potential partner has a track record and experience in the technical, logistical and other aspects of remote long-haul rural connectivity interventions. It is important that the institution favors the utilization of appropriate technology and that such institution is not "locked" to a single equipment manufacturer. It is also important that the institution does not subcontract all the work to a single entity, as this generally implies a disconnection from the local realities.

Another key requirement is that the institution has a track record of direct involvement in the sustainability of these initiatives beyond the funding period; this is generally proven by having business creation components in their project development cycles. Naturally this implies that they possess experience working with locals for capacity building, small business creation, and incubation of small businesses and entrepreneurs in the medium and long-term periods.

The institution must be preferably national of the target country and preferably has ties to target locations, if these are known. Another important requirement is an integral and multidisciplinary vision of the area where the intervention will take place, some of them presenting complex realities dictated by culture, religion, superstitions, and other components; more so if communities have been isolated and technology had not been present.

Social enterprises, foundations, NGOs, cooperatives, and for profit enterprises are all appropriate for partnership. It is important to note that one must not be misled by the nature of the potential partnering organization but to put emphasis on the mission, vision, goals and track record of the organizations in providing appropriate solutions with the desired components. Social enterprises are attractive as they are generally tied to areas with high degree of community building and have had better results in areas where stockholder-like private for profit organizations have not had success [21]. Another attractiveness of these organizations is the

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fact that they are more aggressive than Foundations and NGOs, providing also characteristics of private for-profit institutions [21]. Additionally, their diversification of sources of income welcomes partnership, thus depending not only on grants, but also providing entrepreneurship, creating sources of employment, and investing back any earnings into the very community they serve.

In practice, however, finding an organization with all the above requirements is not always possible, in which case priority will need to be given to the most significant characteristics and leverage the lacking components through the funding institution's experience in the area or through the partnership with additional institutions, subject to the requirements described above. In a third remote data connectivity project that is being carried out in Bolivia, for example, an institution with at least two desired characteristics was not available. Given the government regulations on NGOs and the current pressing needs, recent graduates were recruited through the IEEE Section, local universities, and other institutions. Then the Peru project was used as a basis to transfer knowledge and know how to these students. This process has resulted in the creation of an enterprise that will be the first in the nation that gathers all areas desired.

5.2. Socialization

While top-down socialization is a key variable in determining the short-time success of the project (i.e. there exists local and regional government support for implementation), appropriate bottom-up socialization will determine the long-time success of the project, as citizens will be involved in the continuity of the operation of the project in spite of any challenges.

Regardless what sustainability model is being adopted for a social-oriented initiative, local citizen support and their good understanding of the nature of the project can be essential for the initiative's short and long-term sustenance. Indeed, in contrast to a "foreign" project (of which some telecoms networks in dense areas are an example), when the implementation of a well socialized project begins, most local citizenship and leadership are acquainted with the various project components (i.e. are aware of the social focus of the project and the role of the different parts of the infrastructure), are involved in its implementation, and will lobby before appropriate authorities when there are issues with the infrastructure or its administration. In the same manner, when the implementation ends, most locals are aware of how specific benefits would come and the potential at medium and long-term periods. In addition, there is a clear idea on how the local citizen will play a role in the sustainability of the project.

Citizen bottom-up support increases the chances of surviving government political changes and can contribute to fastening a highly bureaucratic administrative process; it also improves the possibilities of influencing local and regional leaders and institutions, particularly during local meetings, lobbying, and processes that are common in rural communities such as participatory budgeting and other participatory decision making processes.

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Figure 8. Most local citizens of the benefited villages participated in different aspects of the implementation.

Figure 9. View from one of the 60-meter (200ft) towers.

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Proper socialization also implies avoiding any misunderstandings or infusing false expectations. In the socialization process, in an effort to appeal to the locals, it is important not to promise services, such as mobile telephony, Internet to all households, or others that do not match the short or medium-term foals of the initiative. This is especially important in areas where governments and good-willing international organizations have been paternalistic or have promised and not fulfilled in the past. The Peruvian project, for example, focused on health as a first stage; thus care was taken in highlighting that fact. It was also highlighted the plans at the short, medium and long term and the paper that locals will play in each stage.

5.3. Implementation and logistics

Part of the reason some regions lack connectivity or other critical aid is because of the inability or feasibility of telecoms and other organizations to reach remote locations during implementation and maintenance stages. In an average humanitarian or disaster relief initiative, immediate infrastructure implementation is generally given the most attention, unless the training and empowerment of locals is explicitly mandated. This focus can be due to urgency (such as disaster relief or limited funding) or the fact that training, capacity building and empowerment might not be high in the goals of the project as other more compelling goals need to be fulfilled.

At the implementation stage, our experience showed that equipment providers were generally on-time delivering material to a major city. However, the remote nature of the project delayed on site delivery for days or weeks. This was because of transportation problems (e.g. low level of rivers) and issues such as defective equipment, missing parts, or infrastructure redesign because of unforeseen challenges. For this reason, we recommend that the initial testing of equipment and validation of shipping documents should take place close to the distributor. The main partner experience in this area is paramount for success in logistical issues.

It is also important to differentiate between infrastructure implementation (which is composed of installation of towers, cabling of radios and other equipment, and others) and the pre and post-configuration and tuning of equipment, generally considered part of the implementation. This later job could take days or weeks, depending on the topology of the land, type of technology utilized, the level of localization of the administrative and the operation components, and the level of education of the locals being trained. It is important to note that in some cases, perfectly erected infrastructure might not work efficiently or not work at all because of configuration

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issues. Indeed, the implementation stage of the Amazon project could have been completed in 10 days, but in fact took ten weeks. The implementation was the classroom for new local administrative, management and technical leadership that are playing key roles sustaining and expanding the infrastructure. The costs of a prolonged deployment were absorbed by the help of locals, partner institution employees and volunteers. Furthermore, the participation of these stakeholders constituted an investment given that locals are familiar with remote locations and implementation and maintenance become easier tasks. It is important to underline that there needs to be a balance between security, efficiency, training and technically sound results, with security not being compromised.

5.3.1. Contracting

In spite of the experience of the main partnering organization which might have limited experts in the field, some very specialized work will need to be contracted to local or regional experts. The nature of the contract work will determine the availability of contractors in remote areas; the more technically specialized the work, the further one will need to go from the target location. However, in the absence of local or regional expertise, a main partnership is vital in capacity creation of local actors, the creation of jobs, and the eventual creation of more specialized entities. For example, members of the main partner were versed with most implementation tasks; when local contractors in a target location were not found, training and capacity creation of a group of interested individuals were carried out in that specific area. Following this process, and in the context of multi-point nature of the project, the lack of specialized workers in one point were able to be leveraged with already trained workers of another point, thus building the foundation for future eventual expansion work and maintenance.

An alternative option that is generally followed by telecoms is nationwide procurement. This option provides the least local capacity creation, unless the agreement explicitly mandates that these components be present in the work.

5.3.2. Volunteering

The participation of full-time and part-time volunteers in humanitarian, social and international development projects is quite common. It is also common, in various disciplines in developed and developing nations, to engage recent graduates as unpaid interns in order to earn experience or for them to use the project for a thesis topic or as an introduction to a new field.

An important issue in management and logistics is to have a clear role for part-time and full-time local, national, and foreign volunteers. Local empowerment being an important pillar of a project, focus must be put on the local stakeholders and all tools and resources must be focused in coaching and teaching locals on the different aspects of the implementation. Experience has been that, when things do not work, learning/teaching is set aside and high priority is put solving the problem and making it work, thus increasing the distance between real issues and building local capacity. This can be improved by having appropriate partnerships with organizations that have experience in the areas, thus making the above situations a chance to train locals in real issues that arise.

With the exception of natural disaster relief events or when volunteers are present in projects with the sole task of training locals and nationals (e.g. are experts in their field), it is preferable that the ratio of implementation volunteers favours local and national workers and volunteers, e.g. at most 1 foreign volunteer for every 10 local/national volunteers. When the percentage of foreign implementation stakeholders overwhelms local actors, the capacity-building, sustainability plans and overall goals of the initiative needs to be readjusted. This readjustment can be in terms of further research into links with local and national educational and other

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institutions, local and national volunteer recruitment, revising of the main sustainability and capacity creation aspects of the project, and refocus of funding. One big issue in some projects has been the high costs of overseas trips; the redirection of travel funding towards local empowerment and the utilization of ICTs for the alleviation of such trips is highly recommended.

5.4. Technology

Perhaps one of the biggest areas of misunderstanding between some technologists and other disciplines' experts has been on the role of technology on the betterment of livelihoods. Engineers often equate "solution" to the design of technology; others equate solution to the successful implementation of their projects; others equate solution to revenue; rightfully, others equate solution to the improvement of human conditions of the ones that need the most. In this area of improvement of living conditions, technology is just a tool utilized to facilitate and better processes that are generally already taking place.

In remote rural communications case, as in other scenarios, telecommunication technology has to be made appropriate to fit the current needs; thus, the choice of already existing known-to-work technology must be made as a function of the following variables:

A. Localization and cultural characteristics
B. National regulation compliance (current and emerging policy and regulations)
C. Bandwidth necessary and reliability
D. Energy efficiency/availability/reliability
E. Ease of installation, maintenance and access
F. Cost in the short, medium, and long-term
G. Topology
H. Probabilities of equipment being subject to natural conditions, lightning, theft
I. Short, medium, and long-range prospects
J. Effect on ecosystem and environment
K. The prospects of future technologies appropriate to the infrastructure
L. Others

Our experience has been that engineers willing to help in long-distance telecommunication projects have often suggested designing telecommunication equipment for urgent needs, without researching the market for already existing technology. Some have ventured in the area of urgent needs without considering the intricacies of the product cycle, including approvals and other critical issues. It is important to underline that health and other urgent initiatives are no place for experimentation but for the deployment of known effective technologies and processes.[iii] When the infrastructure demands the installation of telecommunication equipment on top of 90-meter towers in the Amazon, the equipment to be utilized has to be proven to work in such circumstances for a long period of time, especially when service will be given to health.

However there are various aspects of technology that can be improved; among them:

- Localization of firmware and software
- Creation of software for one-click user configuration
- Diagnosis tools
- Maintenance tools
- Technologies that can add value to already existing infrastructure (i.e. Environmental monitoring, early warning appropriate technology, etc)
- Add-on tools
- Application of industrial management processes to the context
- Research and development on interdisciplinary or niche areas
- Others.

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The issue of standards is quite important as generally standard-capable technologies are cheaper, more flexible, and a solution is not locked to single vendors. However there are always exceptions and other options must always be open, including the recommendation for standard-creation bodies such as appropriate IEEE standard groups. It is important to underline that, in our context, standards generally lower the cost of equipment, but not necessarily make better or appropriate technologies. Another important issue to consider is that standards have generally been focused to "mainstream" markets, leaving aside others. This is the case of long-distance Wi-Fi, where equipment manufacturers, through the evaluation of real needs, have carried out proprietary changes to standards in order to provide desired services and flexibility.[iv] However this has caused projects to be locked to single vendors, thus sacrificing costs and functionality in the long run.

5.5. The importance of a sustainability plan

Engineers, technologists, business people and international developers tend to focus their efforts differently. Technologists generally measure results based on the success of implementation and maintenance of technology; business people on profits resulting from usage and maintenance of infrastructure and services; international development organizations and NGOs through impacts and outcomes that are set in the context of their timeframe, main components of their programs, cross-cutting issues, and requirements of funding organizations.

In a real scenario where time, resources, and intentions of the partners are favourable, all these areas should be considered, over a short, medium and long period of time as part of a formal innovative business plan with components such as capacity-building, medium and long-term maximization of benefits to the local population, and expansion to other areas. These initiatives must not be limited to program cycles but be open ended, possibly lasting more than five years. Thus the importance of bottom-up and top-down socialization.

The nature of the project (health, technology, sanitation, water, roads, and infrastructure) has played an important role in the ability of the local population to sustain it. For instance, villagers in various parts of the world are known to have good organization for when the potable water infrastructure fails, electricity infrastructure is not operational, portions of the road are washed away by floods, or there's the need of important fixes. Appropriate telecommunications infrastructure has the potential to become one of the most straightforward infrastructure to service because of its packaged nature, lowering price, and the emergence of technically oriented new generations. In the Amazon project, volunteers in various parts of the world were able to encapsulate innovative scripts and software for one-click configurations and reconfigurations of equipment, thus enabling locals to service and replace parts quite efficiently.

In our particular case, one important factor that favoured the success in the health sector so far, is the fact that operationally, health centres depend on the main hospital; and administratively, the main hospital is served with statistical and case information that higher health authorities demand – positive results justify their funding. This two-way dependency merged with communication technology enhances further their relationship. Thus, in projects of this kind, note will need to be taken on the administrative-operational dependence, as this might be one of the most important characteristics for the sustainability of a project.

6. Conclusions and future work

This paper provided a background of a long-distance connectivity project carried out in a poor and economically challenged remote rural area of the Peruvian Amazon in a region that has

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minimal prospects of adequate digital connectivity for the next ten years if left to commercial organizations. Given that similar situations are found in various parts of the world and the fact that governments, telecommunications companies and international organizations have not been able to provide communications that would benefit them for health care, education and other applications, the present paper also provides generalizations of our experiences for use internationally.

We describe collaborations, socialization, the role of a local partner, logistical considerations, dealing with local and international contractors, the balance between international and local volunteers and choice of technology. The initial application of the network is health. We have focused the description on the importance of collaboration among the many stakeholders in order to ensure that the network is maintained and expanded by local people and organizations.

The paper also suggests an adapting business plan for the short, medium and long-term sustainability. The plan evolves over time and involves local participation in the construction, maintenance and expansion of services and the physical telecommunications network. The business model provides an incentive for local people to add services to the network including community kiosks, education, local government, videoconferencing and internet access for local businesses and citizens, with the creation of community telecoms as a final stage. The community nature of the model, the utilization of appropriate technology, and the emphasis on sustainability allows it to be cost effective for local communications.

Given the paper-length limit, the present paper has given only a glimpse of the experiences acquired over more than three years. Future work include the more in-depth description of various issues, the creation of a more formal framework and methodologies for the implementation of these projects, and the in-depth description of the business plan. These will need to be reinforced with the results of other projects currently being carried out in other parts of the world as part of IEEE's ongoing contribution to humanity and to those who need the most.

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[i] The Peruvian Amazon initiative was initially part of IEEE's Humanitarian Technology Challenge.

[ii] "Main partner" or "principal partner" is the main local or national organization that is expert in long-distance data communications, rural health betterment through ICTs, sustainability, and top-down and bottom-up socialization.

[iii] For the purpose of proof of concept and technical pilot experimentations, a testbed was built in Ottawa. Besides the technical learning benefits of such testbed, important aspects of volunteer dynamics, partnerships and other aspects were learned. However the most important role of a stable implementation in the Peruvian Amazon was the experience of the main partner organization.

[iv] This can be the case of Mikrotik's Nstreme or Ubiquiti's AirMax, among many others

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