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Impact, Sustainability, and Dependency:
The Case Of Empower Playgrounds, Inc.

Ammon Franklin

A thesis submitted to the faculty of
Brigham Young University
In partial fulfillment of the requirements for the degree of
Master of Science

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ABSTRACT

Impact, Sustainability, and Dependency:
The Case Of Empower Playgrounds, Inc.

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This thesis studies impact, sustainability, and dependency in the nonprofit sector. Empower Playgrounds, Inc. (EPI) is a nonprofit organization working to improve educational conditions in Africa through educational recreation, lighting for education, and hands-on science labs. A social impact assessment I performed for EPI in 2008 creates the context for discussion of EPI's sustainability. Dependency results from a lack of sufficient conditions for sustainability—resources, capability, and opportunity—which I elucidate in a framework of corresponding theories of capital. Using this sufficiency framework I analyze the resources, capabilities, and opportunities required for EPI program sustainability, determine unmet conditions, and propose solutions to improve sustainability. This thesis contributes to the nonprofit sustainability literature by combining problem-driven (as opposed to solution-driven) design processes with theories of capital to assess nonprofit program sustainability. This framework is a powerful planning and assessment tool for both business model generation and program design.

Keywords: dependency, sustainability, participatory research, development education

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INTRODUCTION

In fall of 2008, Matthew Colling and I performed a social impact assessment of Empower Playgrounds, Inc. (EPI), a nonprofit organization working in Ghana. Our findings led me to question EPI's sustainability and the nature of its continuing relationship with program participants. After first introducing the concepts of dependency and sustainability, Part I of this two-part thesis lays the contextual groundwork for a subsequent sociological analysis of EPI's sustainability. The framework for analysis combines principles of problem-driven design and theories of capital to provide a planning and assessment tool useful to both organizations and programs. I include revised portions of the social impact assessment performed for EPI in sections I through III as context for the application of my assessment framework. Section I provides an overview of EPI's program (Appendix A provides the Ghanaian context in which EPI operates). Section II includes the methodology of the social impact assessment. See also Appendices B and C for further information on site selection and assessment methodology. Section III presents abbreviated observations from the social impact assessment. After the social impact report was submitted to EPI I distilled three critical systemic constraints from the impact assessment, which comprise section IV: teacher absenteeism, centralized planning and control, and solution-driven program design. These systemic constraints—overarching factors that have inhibited both EPI's impact and sustainability—led me to formulate this thesis. Together these four sections detail the problem context, an essential part of understanding the problem prior to generating solutions through a problem-driven as opposed to a solution-driven design process.

While Part I summarizes the impact research, Part II analyzes EPI's impact sustainability utilizing the context provided by the social impact assessment. The purposes of Part II are to 1) generate a sociological framework, or tool, which will facilitate inquiry into the causes of

dependency within any international development context, 2) utilize that sociological framework to analyze potential weaknesses in the particular case of EPI's program sustainability, and 3) propose solutions to dependency-generating factors which may be found in EPI's program.

Part II comprises four additional sections and the conclusion. Section V provides methodological information, in addition to that provided in section II and appendix C, which pertains to the grounded theory approach I have taken in the second part of this thesis. Section VI creates a framework in which to analyze EPI's program. This framework relates the concepts of physical, human, and social capital to each of the three respective categories of necessary conditions for sustainability discussed previously: resource, capability, and opportunity. I delineate the specific conditions necessary for EPI to attain program sustainability in section VII, including a discussion of each unmet condition as it relates to the framework previously mentioned. Subsequently, in section VIII, I discuss potential solutions to the dependency-generating factors presented in the previous two sections. The final section concludes and summarizes the information presented in this thesis.

This thesis contributes to the impact and sustainability assessment literature by combining concepts of problem-driven research and design—as opposed to solution-driven research and design—with theories of capital. This combination of concepts produces an effective framework not only for assessment of organizational structure and behavior but also for program planning and innovation within the nonprofit sector.

Dependency

Dependency is one of two central concepts of this thesis. In the forward to *Succeeding at Social Enterprise: Hard-Won Lessons for Nonprofits and Social Entrepreneurs*, Robert Egger recounts a personal experience serving meals to the D.C. homeless:

Although feeding folks was right, I realized that we hadn't done anything to help them off the streets and out of the rain. It was at that moment that I became aware that we had, with love in our hearts, set these men and women upon an endless loop. This model was designed to redeem us, the givers, not liberate the receivers. Therefore, nobody was truly being served. We had all become stuck in a cycle that would be repeated the next night and the next night, and the next. (Social Enterprise Alliance 2010:xvi)

Egger's statement reflects the core of dependency theory—that good intentions often do nothing to alleviate the perpetually dependent state of the needy. Otherwise stated: there is no final resolution of the problem, no exit strategy for the organization.

It is important to note the difference and relationship between *dependency* and *dependency theory*. Beginning at about 1950 theorists and researchers began to ask questions about the economic relationship between rich nations and poor nations.¹ According to the Singer-Prebisch thesis—the foundation of dependency theory—poor nations' trade terms were becoming increasingly unfavorable (Bloch and Sapsford 2000). Essentially, dependency theory speaks to corrupt or inefficient flow of resources. Bloch and Sapsford confirm the trend in trade terms with data spanning from 1948 through 1993 (2000). By the 1960s this thesis became a full blown reaction to modernization theory, the idea that poor nations must follow the same linear stages of progression that rich Western nations once passed through (Rostow 1959). Dependency theorists claimed that rich nations' actions vis-à-vis poor nations created a detrimental, even impoverishing relationship, due to the prescription of a one-size-fits-all solution: linear modernization.²

¹ It is interesting to note that dependency theory came about at roughly the same time as human capital theory, discussed later in this thesis.

² The single solution approach reveals an incorrect understanding of the different problems in developing nations, as I argue later in this thesis.

Dependency theory applies not only to private sector business relationships between rich and poor nations; it applies to international development as well. This may be the area in which dependency theory has most vehemently argued against modernization. Although dependency theorists have long argued in opposition, policies formulated on modernization theory continue to be enacted by international aid organizations. An oft-cited and much-researched example is the structural adjustment programs (SAPs) of the 1980s. SAPs were loan-for-policy-change arrangements with poor nations. Poor nations enacted policies—often related to market liberalization—dictated by Western nations in exchange for “investment” loans for sectors like education (Khôi 1976; Riddell 1999). Though promised to promote “take off” into stages of economic growth Western nations had passed through, in reality policies frequently destabilized economies and compounded national debt (Dollar and Svensson 2000). Many of the education related programs had little positive effect due to poor use of resources (Hanushek 1981; Khôi 1976; Levin 1988). Debt servicing—which is ongoing for many of these nations—creates resource dependency. Billions of dollars in relief and development aid is now funneled to developing nations annually while long requested debt relief has been denied.

Similar processes occur at a smaller scale in non-governmental organizations (NGOs). Resource Dependency Theory (RDT), a concept originating in the field of organizational behavior, is one of the primary concepts behind the push for fiscally sustainable nonprofit organizations (Miller-Millesen 2003). Social entrepreneurship is the phrase of the day in the philanthropic sector as organizations attempt to create more sustainable income streams. The definition of a social venture is a point of disagreement. Although simplified, social entrepreneurship pertains to social business models with the ultimate goal of becoming less dependent on individual donations and donor agencies through diversifying into ulterior income

streams. One simple example is in the microfinance industry where charging interest on micro-loans allows organizations to both cover administrative costs and expand program coverage. Examples of other nonprofit organizations utilizing business principles include the gift shops that are an important part of museums' income streams, and the sale of cookies by Girl Scouts. In international development organizations have sought multiple markets for poverty relieving products or services, such as sanitation systems, which may be sold for profit in wealthier markets in order to subsidize sale or provision of such technologies among the poor.

Even as NGOs seek to relieve themselves of resource dependence, these same organizations should be equally if not more concerned about the resource independence of their clientele: the world's poor and needy. *Dependency* as concerns the clientele of development organizations relates to the two core concepts of international development: impact and sustainability. *Impact* in the field of development refers to the size or scope of change being effectuated. *Sustainability* is the permanence of that change. If change requires constant or periodic intervention it is not a sustained change: the client is resource dependent. The assessment framework developed in this thesis may be used to analyze resource dependence among NGO program participants as well as resource dependency in development organizations. *Sustainability: Resource, Capability, and Opportunity*

The term *sustainability* has diverse meanings. Let us first distinguish between *organizational sustainability* from *impact sustainability*. The former refers to resource dependency theory, or the stability of an organization's income. As discussed above, organizations attempt to diversify income streams to reduce resource dependence thereby allowing continuance and expansion of their programs. Discussion of impact quality is important to organizational dependency only by virtue of its influence on resource acquisition. Much of the

literature on nonprofit sustainability references the external resource sustainability of organizations; in other words, an organization is sustainable if it has a reliable and predictable income stream (Hillman and Dalziel 2003). In recent years concern over sustainability has propelled the idea of social entrepreneurship: ventures with double- and triple-bottom-line business plans (Social Enterprise Alliance 2010).³

Conversely, impact sustainability refers to the longevity of change effectuated through the use of organizational resources among its clientele. Just as nonprofit organizations are seeking to promote their own resource sustainability, they should design programs that promote their clientele's resource independence. "[L]ong-term improvement of economic and social conditions," is how Reinhard Stockmann describes impact sustainability (1997). Impact sustainability refers not only to economic and socio-cultural, but also to ecological factors (See: Krank and Wallbaum 2011; Xing et al 2009).⁴

Diminishing human privation without also creating dependency is the core problem of international development. Without impact sustainability NGO program beneficiaries are dependent on the program facilitator to continue involvement. If involvement ceases, the benefits of intervention may cease or reverse (Nkansah and Chapman 2006). Both resource dependency theory and the concept of impact sustainability should be applied to the programs nonprofits

³ The three bottom lines are profit, people, and planet. Profit is the traditional bottom line of business, although social entrepreneurship—which differs from traditional businesses by virtue of the priority of its bottom lines—prioritizes either or both human welfare and ecology above profit.

⁴ Ecological definition of *sustainability* has to do with decreasing permanent negative impacts, particularly as pertains to natural resources. It is noteworthy that *sustainability* in the ecology literature almost uniquely refers to impact sustainability rather than resource dependency, while in organizational behavior and business management sustainability usually refers to resource dependence.

implement. Sustainability, as pertains to the analysis of EPI's program refers to impact sustainability, not organizational resource dependence. The reader should note that the framework developed in this thesis may be equally applicable to organizational sustainability.

Relating Dependency and Sustainability

Dependency, a central concept in this paper, relates to the *sustainability*, not the *impact* of a program. Again, *impact* refers to the quality or magnitude of the influence and *sustainability* to its duration. In order to establish a common understanding of sustainability as it relates to dependency I will frame the concepts in terms of necessary and sufficient conditions. The three statements below concisely explain necessary and sufficient conditions:

Circumstance Y is a necessary condition of circumstance Z if Z implies Y.

Circumstance Y is a sufficient condition of circumstance Z if Y implies Z.

If Y is necessary to Z, then Z is sufficient for Y.

One may also find several necessary conditions that constitute a sufficient condition when taken in conjunction. I propose that the necessary conditions for sustainability are *resources*, *capability*, and *opportunities*. None of these three necessary conditions by itself is sufficient for sustainability, but the conjunction of the three is. Conversely, we may state that the *lack* of any of the necessary conditions of sustainability is a sufficient condition for its diametric opposite: dependency.⁵ Because a lack of dependency is a necessary condition of sustainability, a related but causally different logical statement can then be derived: sustainability is a sufficient condition to nullify dependency.

⁵ Practically speaking we should call the sustainability-dependency pair gradable opposites. If the reader will permit I will continue along the theoretical vein, maintaining for the moment that sustainability and dependency are diametric opposites.

The goal of sustained long-term impact requires attention to *resources, capability, and opportunities*. Inhibiting circumstances beyond the control of program participants are sufficient conditions for dependency. The focus on contextually appropriate resources, capacities, and opportunities for each program-context combination is at the core of eliminating the perpetuation of dependency in the nonprofit sector. From the preceding description of the necessary and sufficient conditions for effective international development we can state the following sequence of logical statements:

Sustainability is the opposite of dependency.

Sustainability is a sufficient condition to nullify dependency.

Resource, capacity, and opportunity are necessary conditions for sustainability.

Lack of resource, capacity or opportunity is a sufficient condition for dependency.

The idea that sustainability requires specific resources, capacities, and opportunities is a cornerstone of this research. The context in which I apply those concepts is the case study of one specific nonprofit organization: Empower Playgrounds, Inc.

PART I

Empower Playgrounds, Inc. (EPI) is a Utah-based nonprofit corporation that proposes to enhance education in rural Ghanaian schools by providing power-generating playground equipment and rechargeable LED lanterns to students and teachers in villages off the electric grid. These lanterns are intended for dark classrooms, night time study groups, and teacher preparation. EPI's goals are to provide (1) educational recreation that makes learning more fun for children, (2) light for education at school and home, and (3) hands-on science labs for the children. While the first two goals are implemented with a merry-go-round (MGR) system, the educational modules and learning tools are presently under development and testing.

EPI hired Ammon Franklin and Matthew Colling as independent consultants to assess the social impact of EPI's program and to suggest ways to refine EPI's capacity to promote its three primary goals. As lead researcher I was given the mandate to identify the impacts of EPI's program and to judge their merits. The additional mandate to provide suggestions for program improvement was explicitly stated in my discussions with EPI's founder.

Section I: Empower Playgrounds' Solution

To avoid disassociation from historical context, I include in appendix A a short review of Ghanaian history and then relate it to the country's present educational situation. Appendix A also briefly discusses the present lighting options in rural Ghana. Collectively, these factors describe not only the context in which EPI is functioning, but the problems EPI hopes to redress.

EPI's Solution: Power-Generating Merry-Go-Rounds

Many non-governmental organizations (NGOs) attempt to tackle the problems that lack of lighting and power create across a country. A former American missionary in Ghana founded EPI with the intention to bring small amounts of light and power to rural Ghanaian villages. The

problem, as defined by EPI, is that children in villages have insufficient lighting for study and inadequate educational recreation equipment.

The original EPI concept was an outgrowth of its founder's experience in rural Ghana. In collaboration with students at Brigham Young University (BYU), EPI engineered and fabricated its first power-generating merry-go-round (MGR) in 2008. The first prototype was duplicated and installed in an Accra private school that same year. Divergent manufacturing processes, capabilities, and materials in Ghana led the BYU and Ghanaian teams to make considerable ad hoc adjustments in the original Ghanaian prototype. Later that same year EPI replaced the initial MGR with a more durable but equally problematic design. This beta prototype was installed in Essam, a village several hours outside of Accra, but experienced frequent mechanical failures. Problems with the initial Ghanaian prototype were primarily structural design issues. In the beta prototype issues remained with the power-transfer joints, gear ratio, and charge control circuitry. In the wake of additional modifications to the beta prototype, a working model was duplicated and installed in five previously selected villages.

The MGR uses a Toyota Land Rover hub both as an axle and to transfer power through a 1:30 ratio gearbox to an electric generator.⁶ Power lines run from the generator through underground PVC piping to a nearby secure location, frequently a school office or storage room, where the "black box" is kept. The black box contains a 12v car battery and charge control circuitry to maximize both charging and discharge of the battery. Originally, top of the line deep cycle batteries, unavailable in Ghana, were imported for this purpose. Generally, 15-30 LED lanterns are provided with each MGR system. Up to five LED lanterns can be charged

⁶ Due to ongoing changes in the MGR design, some of the design information may be different on equipment EPI has placed in use. For example, EPI implemented various gearbox ratios at different times.

simultaneously from the black box. School administrators and teachers form study groups, with an optimal group size of 4-6 students per lantern, and assign a “Lantern Leader” from each group. The Lantern Leaders are responsible for the care of the lanterns and must bring them to school each day, regardless of whether the lanterns need charging.

Typical MGR system installations take a single day with almost complete pre-fabrication and testing taking place at EPI’s main shop in Dzorwulu, a suburb of Accra, Ghana’s capital. Soon after the installation, school, district, and other education authorities join village elders, parents, and schoolchildren for a school assembly. The gathering is intended to engender feelings of communal pride and ownership for the new equipment, as well as to invigorate community interest in the power of education. School administrators ceremoniously assign Lantern Leaders are numbered lanterns with accompanying daily use log sheets. The community is collectively instructed on these leaders’ new responsibilities, as well as rules of use for the lanterns. Following an explanation of the technology’s purpose, function, and use, EPI personnel unveil the equipment. After a ceremonial turn on the MGR by an official such as the village chief or presiding elder, children line up by group or class and take their turn on the MGR. In the excitement-charged atmosphere it is often difficult to keep the entire unit from being completely covered by impatient children, sometimes upwards of 50. In the evening of the same day students begin to study in groups under the light of their pre-charged LED lanterns.

Section II: Social Impact Assessment

The social impact assessment process comprised two main phases, first, pre-installation ethnographic research, and second, post-installation evaluation research assessing EPI’s stated goals against actual results. To provide sufficient detail on the social impact assessment process this section includes subsections on study timeframe and locations, research questions, and

research limitations. See appendix B for further information on EPI's site selection process and appendix C for data collection methods). The study was approved through the Brigham Young University campus Internal Review Board. I followed standard ethical rules and procedures in my interactions within the research environment.

Research Timeframe and Locations

Both pre- and post-installation observations were conducted over a five-month period from late July through the end of 2008. As lead researcher, I arrived in Ghana in late July and stayed through early October. After a short collaboration period in the United States, Matthew Colling went to Ghana and continued observation through the end of the research period.

EPI employees and a volunteer cohort of BYU Masters in Public Administration (MPA) students selected five project locations from a list of 18 villages provided by educational personnel from the Greater Accra Region. All of the villages were within roughly one hour's travel of Accra, and within the Greater Accra Region. Each village was required to have a school not equipped with electricity. For additional information on the implementation site selection process, see appendix B. The data collection methodology and approach are described in appendix C.

Research Questions

I share the assumption with Khamis and Sammons (2007) that educational change is best actualized when attention is paid to individual school contexts. Thus in framing the research level and unit of analysis I have attempted to consider each project locale as a distinct research environment while simultaneously attempting to distill overall patterns in how EPI's project interacts with and impacts small, rural communities.

My purpose was to assess the various categories of impact EPI had in its project locales. My primary areas of interest are social change and educational change. Additionally, the use and reliability of the MGR equipment are of importance not only in that they affect the project's impact and sustainability, but by virtue of their interaction effects on social and educational change (See Nolan 2002:168). Under each of several research categories below, I specify several specific research questions I addressed.

Functioning of the MGR system

Is the technology functioning as expected? What works well? What elements seem to be the problematic? What solutions are available to repair and maintain the technology?

Control of the MGR system

Who controls access to the technology? Who maintains it? Who secures it at night? Who accesses the technology? What are the selection criteria, if any? Is there weighted access, and if so, by what criteria (Wealth, land, occupation, need, other)? Is control abused?

Actual use vs. ideal use of the MGR. How many hours is it used per day, per week? Do the children tire of it, or get bored? Are the children encouraged to use the MGR when they don't want to? Are adults or families using the technology? Is the MGR used uniquely during school hours, or after school hours as well (and how much of each)?

Actual use vs. ideal use of lighting. How much MGR time is used for child education, adult education, economic/household/leisure activities, other, etc.? Are there actually "more hours" of light being used? Are there more man-hours of light being used (more people using the light—and for more purposes—because it's brighter)? Is there gender parity? If not, in what ways?

Educational impact of the technology. Is the science curriculum being used? In what form is the curriculum used? What deficiencies are apparent? What adjustments have been made? What adjustments should be made?

Access to the technology. Is access egalitarian? Do villagers feel that access is egalitarian? What were typical patterns of time use? Have they changed? If so, in what ways?

Social impact of the technology. In what ways has family life been affected by this technology? Do families use less kerosene or other lighting fuels? Do they use fewer *bobos*⁷ and liquid fuel lanterns? Is quality of life improved overall? Is there conflict over access? Is there any inter-village conflict or jealousy? Is there threat of sabotage or vandalism? Are there other factors we may not be aware of?

Assessment of feasibility. How can we improve chances of equitable and efficient use of the technology at six months, one year, and two years? To what degree are the effects of the project economically viable? If power generation fails, but the merry-go-round is still used, will the equipment be abandoned? How much mentorship and guidance is needed to sustain the project? What problems were encountered as to the actual use vs. ideal use, and how might they be improved upon? What social problems have come from this project's implementation, and how might they be improved upon? What educational deficiencies are present, and how might they be improved upon?

Suggestions for improvement. How can we improve chances of equitable and efficient use of the technology at six months, one year, or two years? What problems were encountered as to the actual use versus ideal use of the equipment, and how might they be improved upon? What social problems have come from this project's implementation, and how might they be improved

⁷ Bobos are a common type of open-flame kerosene lamp, often made of old tin cans with a rudimentary wick.

upon, or eliminated altogether? What educational deficiencies are present, and how might they be improved upon?

Section III: Summary of Observations

I assessed the advantages and disadvantages of EPI's program in terms of three domains: equipment reliability and use, social change, and educational change. In Table 1, below, I include several of the key patterns of change due to EPI's program. In addition to the general patterns observed in all five villages, there were several observations unique to individual villages that are included in parenthesis.

[Table 1 about here]

In order to distill the most pertinent issues for sociological analysis I adapted Bhola's (2000) framework to categorize the various program impacts under the following three categories: intended outcomes, unintended outcomes, and future consequences. I do not include this categorization in this thesis, but state simply that outcomes likely to have the greatest unintended future consequences should be of greatest interest to EPI.

The observed patterns in these villages vary according to severity as well as difficulty of remediation. Among the most troubling observations from EPI's standpoint includes the fact that children didn't use the MGR enough to generate sufficient electricity for the study lanterns.

Mechanical/Electrical

Although not explicitly mandated by EPI, an assessment of EPI's technical merits contributes to an understanding of how its impact will be seen over time (Nolan 2002). Not only will communities lose faith in any equipment that proves unreliable, without an efficient and effective system the true long-term impacts of EPI's program will be difficult to discern.

Major advantages of the MGR system include an efficient balance of power generation and ease of play, as well as highly efficient battery charging circuitry. Unfortunately, these elements are costly. Notable disadvantages included unreliability of power-transfer joints and the complexity of the charge control circuitry. The overall complexity of the system creates a dependency on EPI and necessitates frequent maintenance, extra mentorship, and higher administrative costs.

While Lantern Leaders have charge of the lanterns and are vigilant in taking care of them, the large plastic lenses of the LED lanterns are susceptible to scratching. On the very first evening after the first installation, several units incurred damages. Although cosmetic, the damage demonstrates the harsh environment the lanterns will undergo in rural Africa.

In addition, the children's power output was insufficient to charge all of the lanterns allocated. I suggested EPI place inexpensive bicycle rotation counters on the MGRs to determine the number of rotations for each MGR over a period of time. Correlating logged rotations and corresponding power levels of the main battery with demographic data—such as the number of children at the local school—would provide invaluable data in selecting future project locations. EPI has calculated that to charge all the lanterns in an average village, the children would need to play on the MGR approximately five to six hours daily. Because children are not producing sufficient energy EPI is now utilizing supplemental photovoltaic power sources.⁸

Social Change

I observed a substantive increase in community support for studying in general and particularly studying at night. One of the initial manifestations of social awareness I saw in those communities selected to receive MGR systems was a collective effort to select and prepare an

⁸ Play time actually fell off precipitously.

installation area for the MGR. Solomon Tenadu, EPI's Country Director, guided site selection in consultation with local school personnel and village leaders. Once sites were selected, a school administrator or SMC member (typically the chairman) would organize the village effort to prepare the area for the MGR installation. At the first MGR system installation in Adenkrebi, as well as in three of the four remaining installation sites, the village men spent a considerable amount of time clearing and leveling the ground, including the removal of several small boulders.

In all five locations, village chiefs and elders were well versed in EPI's purposes and intents and were able to rally the community to support the initiative. This was not simply an important gesture; rather, it became and should remain a crucial component to the success of any new program installation. If for any reason a village chief or group of elders becomes displeased with EPI, its efforts, or its equipment, the program could cease to impact the village entirely.

Disadvantages observed thus far have been linked to early-stage equipment failures, creating the potential for a lack of faith in the overall project in some communities. As with any new program EPI will need to continue system improvement in order to mitigate community concerns arising when equipment fails to fulfill its promised capacity. An honest assessment of EPI's social impact should include the simple fact that EPI's specific activities may not be any more effective in creating community awareness and focus on education than any other NGO's program. The offering of any NGO service may provide impetus for similar social action.

Educational Change

During surprise night visits on numerous occasions I observed not only children studying together in their assigned groups but also local administrators or teachers using the lanterns to prepare lessons and grade papers. An advantage to providing this technology is teachers'

improved motivation to teach more effectively. In a permissive educational structure, another advantage includes the benefits of external oversight of the educational program. One significant negative change was noted, however. In the rare cases where children had been studying with parents or grown siblings, new study groups tended to take them out of that setting and into a peer study setting. Depending on the comparative efficacy of the parental influence, this change may represent a significant disadvantage.

Based on my observations of EPI's program, I was impressed with not only the originality of the proposed method to improve science education but also with the dedication and conviction that drives EPI's founder, board of directors, and employees. Midway into the social impact research, despite numerous unforeseen problems in the first round of installations, several MGRs were functional and charging anywhere between fifteen and thirty lanterns each. When functioning, these added a significant new source of light that did not exist in any of these villages before EPI's presence.

School selection is an important component to the program's continued success and the US based university students involved in this portion of the program have modified and rectified the selection criteria accordingly. EPI's internship program, administered through Brigham Young University, gives MPA and engineering students an opportunity to practice their acquired skills in an environment which forces them to not only draw upon their theoretical backgrounds but also to think of new solutions in a foreign setting. Certainly a byproduct of EPI's program will be better-trained university graduates who have the opportunity to participate in EPI's activities in Africa.

Section IV: Systemic Constraints to EPI Effectiveness

The following systemic constraints were derived from observations during the social impact assessment, but conceptualized after EPI received the impact assessment report. EPI's program sustainability is mitigated by three systemic constraints: one in the operational context, and two in the organizational context. In the operational context teacher absenteeism represents the most significant impediment to EPI program efficacy. In the organizational context both centralization and solution-driven (as opposed to problem-driven) program design contribute to a lack of program sustainability and subsequent dependency on EPI.

The conceptualization of these constraints initiated the association of international development applications of capital theories with the problem-based program design for use in sustainability planning and assessment. The following three subsections address each of these three topics respectively. Section VII includes solutions proposed for these constraints.

Teacher Absenteeism

Teacher absence from the classroom represents a negative impact on student achievement (Woods and Montagno 1997). Teacher absenteeism in Ghana is extraordinarily high, yet until very recently this significant education factor received relatively little attention (Steiner-Khamsi and Harris-Van Keuren 2009). A variety of results have been found in the Ghanaian context.

A study cited in USAID's white paper on teacher absenteeism indicates that 20 percent of Ghanaian teachers are absent and an additional 29 percent are tardy on a daily basis (Steiner-Khamsi and Harris-Van Keuren 2009). The Ghana Center for Democratic Development estimates Ghana's overall rate of teacher absenteeism at 27% (2008). Other studies have shown far worse rates by region. In Afram plains teacher absenteeism is an astounding 83.6% (USAID 2005). The informal observations of a math teacher volunteering for 3 months at one of EPI's

program sites recorded overall absenteeism rates of approximately 45%. Absences aside, this math teacher reported that all but a couple of teachers were tardy on a regular basis.

Reasons for teacher absence from schools vary considerably, yet researchers have identified a number of general patterns. Khamis and Sammons found that in a Pakistani school context the “school environment is oppressive and unpleasant and teachers are given very little incentive to stay in school and apply their professionalism” (2007:577). Khamis and Sammons cite the lack of ownership by teachers (in the Pakistani case by virtue of deputation to other schools), a lack of resources, and low student interest as probable causes for high teacher absenteeism (2007). Seasons also affected absenteeism as reported in a study by UNICEF in the Karnali region of Nepal (UNICEF 2010). According to Glewwe, Holla, and Kremer (2008), factors contributing to teacher absenteeism seem to have more to do with working conditions than with salary.

In a study of Peruvian primary schools working conditions were again tied to absenteeism, with additional mention that low community attachment was a significant negative influence on teacher attendance (Alcázar et al. 2006). Also of interest in the Peruvian study, centralization of the educational structure had no significant impact on teacher attendance. Changing the incentive structure for teachers at or near the educational facility appears to promote teachers’ presence in class. Yet, logically, absences have little impact on pay due to a systemic lack of accountability measures. In Ghana, I observed similar disincentives to regular school attendance. For example, teachers had to either leave early or skip work on Fridays in order to access their pay during regular bank hours. When cost of being caught is low or nonexistent, incentive to work is also low. In this case the teaching field resembles other labor areas (Patrinos and Kagia 2007).

Although addressing teacher absenteeism is outside of EPI's chosen area of influence, EPI's potential for success in creating positive educational outcomes is nonetheless dependent upon teachers in the villages. Teacher absenteeism hamstrings the complex solution EPI proposes. The program sites EPI has chosen may, therefore, represent a premature implementation context.⁹

Centralization

Decentralized educational strategies are increasingly preferred to centralized approaches (See Geo-JaJa 2004; Geo-JaJa 2006; Maclure 1994). Decentralized approaches to educational improvements are used as a form of community empowerment (Nielsen 2007). The overall effectiveness of decentralized approaches over centralized measures has been amply shown (Bray 1999; Geo-JaJa 2004; Geo-JaJa 2006; Kendall 2007; Tal 2004). Reforms in West Africa have espoused the benefits of decentralization for many years (Maclure 1994).

Observations of EPI's decision-making processes indicate a centralized governance model. Since the observed implementation stage the founder has also become the acting executive director. Executive decision-making power appears narrowly distributed beyond the founder. During the observed implementation stage, discussions with EPI personnel pointed to the possibility that there was a tendency for the founder to be unable to fully implement or synthesize suggestions by employees on the ground. The founder was aware of this structural

⁹ A note on teacher competence: Survey research at the proposed implementation sites prior to installation indicated that teachers' competence in the scientific principles EPI intended to teach was minimal. I, for one, question the relative utility (developmental appropriateness) of EPI's scientific focus for rural Ghanaians. In either case, lack of teacher competence can minimize positive student outcomes while inapplicable materials may have no substantive impact on rural villagers' lives. Both of these topics should, at some later date, receive additional attention by EPI personnel.

impediment and sincerely entertained possible solutions to it, including placing greater decision-making powers in the hands of the former executive director. Yet, managing such matters remains difficult considering EPI's complex context of social and personal bonds which tightly link board members, employees, family, and friends in the project.

Centralized approaches may not represent significant challenges to small and stable organizations. However, organizational growth and program diversification, like that seen in EPI, necessitate frequent changes in policy and strategy. Multiple perspectives are indispensable for growing aid organizations operating in complex environments such as rural Ghana.

EPI's applied model centralizes control of their program within the public sector by placing control of the equipment in the hands of school administrators, rather than with local persons involved in the SMC or the PTA. Program sustainability relies heavily not only on civic acceptance and control as mentioned previously (Nkansa and Chapman 2006), but on the pre-existing capacity to effectively manage the proposed program on site (Mfum-Mensah 2004). Having been in the applied context, I do no question the ability of people within school administration, SMCs, or PTA to manage the resources provided by EPI. The complicated technical requirements to maintain EPI's program, however, require a more advanced set of skills than exist within the implementation context.

There are additional factors that may compound the relative inefficiency of centralized decision-making, among which include the lack of clear, measurable, and time-sensitive objectives, as well as failure to recognize the limitations of a single epistemological approach (Coe 2001). Founder's syndrome—an expression used to denote an organizational culture centering decision-making on an organization's founder—along with the two previously

mentioned factors have a tendency to exclude valuable perspective in program related decision-making. I will briefly address each of these topics.

Founder's syndrome. Founder's syndrome is not a medical diagnosis, rather it is a term used to denote a pattern of undesirable decision-making behaviors on the part of an organization's founder or founders (Block and Rosenberg 2002). This pattern is typical where effective, decentralized decision making processes are not present or where organizational growth and activity diversification outstrip an individual's capacity to effectively manage multiple stakeholders' interests. Founder's syndrome is common where a single person has been leading an organization since its inception.

As an organization grows and takes on additional personnel or interests complexity is added to both organizational decisions and the parties interested in those decisions. Founder's syndrome can quickly hamstring an organization if the transition to a more mature organizational structure is not operationalized (Block and Rosenberg 2002).

Goals and objectives. As previously mentioned, I was not provided objectives, strategies, or other quantifiable success measures beyond EPI's three mission statements, rather I was given the mandate to perceive impacts and subjectively evaluate them.¹⁰ A simple and common acronym, SMART¹¹, indicates the multiple facets of clear goals and objectives. Well-stated objectives provide the foundation for an organization's division of labor and the vision that motivates employees and volunteers toward a specific end. It is worth noting that organizations can be effective without formally identified goals when the informal culture of the organization and its staff agree on what they are trying to accomplish and how. At times well-defined goals,

¹⁰ If EPI had such a detailed planning document, I was, and am still, unaware of it.

¹¹ The acronym S.M.A.R.T. stands for Specific, Measurable, Attainable, Results-oriented, and Time-bound.

objectives, and strategies may be viewed as a constraint, yet such definition provides clear long-term benefits, particularly as organizations grow. An organization not possessing well-delineated objectives, or which does not adequately utilize those they have will remain less effective than it otherwise could be. Assessments can help to clarify to what extent formal and informal goals and objectives—and agreement on these—is operating in a particular organizational context. Clear organizational goals also create a framework of common understanding which allows leaders to more easily devolve decision-making responsibility.

Epistemic approach. Epistemology, the philosophy of knowledge conceptualization and acquisition, describes a variety of approaches including empiricism, rationalism, and constructivism. I will not address the nuances of each, yet with each epistemic tack comes a number of assumptions and limitations. Recognizing the strengths and weaknesses of a programmatic approach can help promote effective program-impact value chains. EPI's approach to knowledge generation is typical of an empirical—specifically positivist—epistemology. Empiricism is an experiential (sensual perception) approach to knowledge. Positivism is the refined application of empirical epistemology that relies heavily on the “hard” sciences—natural, physical, and computer science.¹² Models of value generation within the positivist paradigm place a premium on information generated through quantifiable, empirical methods with specific tests and applications. We often call this the scientific method.

¹² The following approach exemplifies a constructivist approach to empirically generated knowledge: “Initially, knowledge is produced for the purpose of interpreting reality, but it later becomes a truth in itself. However, reality itself has no value as truth; only the practical value of everyday, concrete doing which stands in opposition to science” (Poikela and Nummenmaa 2006:15)

Quantification is necessarily a reductionist approach and neglects details that may be discovered and described qualitative terms. Generalizability of quantified information, including empirical data, may be extended beyond its usable sphere when unaccompanied by qualitative context. Applications of positivist methodologies within both the hard sciences and soft (social) sciences have been criticized as reductionist for their overall tendency to mute other epistemic interpretations of reality. Ultimately, many assume Western empiricism promises to bring the impoverished into “modern” and productive society. Western assumptions associated with the benefits to scientific solutions often include the idea of linear progress (modernization theory) in helping poor nations follow the path that led the West to where it is (Rostow 1959). Yet, real-life application of empirically generated solutions often encounters unforeseen constraints as Western scientific values contend with social realities in places like rural Ghana.

There can be little question that mathematics, electrical engineering, and mechanical engineering remain at the core of EPI’s nuanced and original approach. Technological solutions are not incompatible with social problems *if* solutions are derived from an accurate knowledge of the problem. I address the topic of problem conceptualization in the following subsection.

Solution-Driven Design

In parallel with the epistemological approaches utilized by EPI, solution-driven design (as opposed to problem-driven design) has resulted in a number of constraints in achieving the kinds of impact EPI desires. In order to more fully explain how solution-driven design has failed EPI, we must look back to a research and educational movement known as problem-based learning (PBL). PBL is an approach to education originally developed within the medical field (Barrows 1996). In the 1960s medical education as an establishment began to realize that medical professionals-in-training needed education more closely resembling the real world.

Education by itself cannot produce complete professional competence, since professional competence incorporates more extensive dimensions of knowledge and knowing. For this reason it is important to create similarities between worlds of education and working life (Poikela and Nummenmaa 2006:13)

The ultimate realization was that medical personnel were putting the cart before the horse. Too often this meant providing prescription and prognosis before complete diagnosis. “The emphasis in PBL is not necessarily on having ‘students’ solve the problem; rather, it is on having them understand the cause of the problem” (Hmelo and Evensen 2000:3). Insufficient needs assessment results in an inadequate understanding of the problem, and subsequently has negative impacts on problem resolution.

PBL disseminated and was adapted into other domains including, among others, design engineering and education. Design engineering assimilated the concepts of PBL in the dichotomy of solution- and problem-driven design where the essential problem in solution-driven design is *problem conceptualization*. Whether an organization is more solution-driven or problem-driven will significantly impact mission-related strategies.

Design problems are widely recognized as being ill-defined problems. It is usually possible to take some steps towards improving the initial definition of the problem, by questioning the client, collecting data, carrying out research, etc. There are also some rational procedures and techniques that can be applied in helping to solve ill-defined problems. But the designer’s traditional approach ... is to try to move fairly quickly to a potential solution or set of potential solutions, and to use that as a means of further defining and understanding the problem. (Cross 2008: 14)

Oversimplifying the conceptualization of the problem can render complicated or creative solutions, as in the case of the solution driven design engineers, which lack the overall quality of optimal impact in the applied context that problem-driven innovation can better provide. This tendency to jump rapidly into resolutions was exhibited by EPI as evidenced by their lack of fundamental research until after full conception of their innovative beta prototype.

In research on quality of design engineering solutions, Kruger and Cross suggest “that the creativity score is related to the design strategy” and specifically to the solution driven model, “However,” they prefaces themselves, “‘creative’ design is not necessarily ‘good’ design” (Kruger and Cross 2006:541, 530). They ultimately conclude that “Solution driven design does seem to produce solutions of high creativity but low overall quality,” yet, “Problem driven design in fact resulted in many solutions, identified few requirements, received a high score on creativity, and a good total score” (Kruger and Cross 2006:545). In the case of EPI, the design of power-generating playground equipment is creative, and interesting, but not particularly effective when compared with pre-existing solutions or variations on similar themes. I posit that this is due to a lack of research into both the problem context and other organizations already working in rural lighting solutions and education.

Clark insists that research and development of sustainable solutions to the world’s pressing problems must include the stakeholders in those problems (2003).¹³ Clark further asserts that the kinds of resources currently dedicated to problem-driven R&D in the security industry are rare in the development sector.¹⁴ While some may dispute how problem-driven the

¹³ “First and foremost, effective R&D systems for promoting sustainability will need to be structured so that they are driven by the most pressing problems of sustainable development as defined by stakeholders in those problems. This will almost certainly result in a much different agenda than would be obtained by continuing to allow priorities to reflect primarily the most interesting problems in science and technology as defined by stakeholders in research and innovation” (Clark 2003:2).

¹⁴ “With a few important but relatively small and under-funded exceptions, efforts to ‘sustain the lives of future generations on this planet’ still lack dedicated, problem-driven R&D systems of anything like the scale or maturity of those devoted to security ...” (Clark 2003:1).

international security industry really is, the point remains that within the multifaceted problem of international development a paucity of information about the true nature of poverty persists.

To take the problem one step further, Miller-Millesen and Mould argue that even those seeking specific training in nonprofit management have little access to resources designed with a problem-based learning approach (Miller-Millesen and Mould 2004).¹⁵ This negatively affects nonprofits' organizational structures, program planning, impact assessment, and sustainability assessment. Some availability of nonprofit focused PBL materials, for example Kloppenborg and Baucus' (2004) article entitled "Project Management in Local Nonprofit Organizations: Engaging Students in Problem-Based Learning." Phills (2005) states the problem this way:

Far too often, basic research is ignored, even when it is potentially relevant to our understanding and management of real problems. And, just as often, our models and frameworks for thinking about such problems are not informed by the rigorous and systematic research that tends to be focused on narrower, but important, parts of practical problems. (P. xi)

Accounting for multiple epistemological perspectives will help, but those without any problem-based training in international development, nonprofit management, or assessment and evaluation may have difficulty perceiving the nuances of problems which is so essential in creating high impact, sustainable solutions and the organizations that can effectively manage them.

In short, had EPI sought first, through multiple perspectives, to better understand the contextual constraints they were later to face in rural Ghana, I suspect that their solution to the problem would have been simpler, more effective, and more sustainable.

¹⁵ "Although there is a formative body of research on curriculum development and problem-based learning, resources available for instructors of nonprofit management courses are somewhat limited" (Miller-Millesen and Mould 2004:249).

PART II

Part I of this thesis included a brief review of the impact assessment I performed for EPI as a contextual framework for the second half of this thesis that addresses the sustainability of EPI's program. Section IV included three systemic constraints EPI faces in implementing effective programs. These constraints guided the inductive process in which I associate research applying theories of capital in the developing context with the concepts of business model generation and problem-driven program design. I apply the results of these combined ideas to the work EPI is engaged in with rural Ghanaians.

Part II is organized in five sections (V – VIII). In section V, I present methodological information on the inductive process which produced this thesis. Section VI utilizes theories of capital to develop a framework for sustainability assessment. When combined with a problem-driven research design this framework becomes a powerful planning and assessment tool. Applying the theories of capital framework, section VII outlines the necessary and sufficient conditions for EPI's program sustainability. A discussion of ways to mitigate dependency-creating aspects from the systemic constraints in sections IV and the unmet conditions for sustainability in section VII follows in section VIII. My conclusion comprises the final section of this thesis.

Section V: Sustainability Research Context

Due to the nature of the present inquiry, the order of this section may at first seem counterintuitive. I first describe the core data informing this thesis, followed by my method of inquiry. Subsequently, I describe the research questions that will, in turn, inform the suggestions to be found in section VIII. Before continuing with section V, I touch on the primary limitations to the present research.

Data

The primary source of data for the present inquiry is the systemic constraints derived from the social impact assessment that Matthew Colling and I performed for EPI (see section II and Appendices A and B). Our study employed informal interviews, personal observations, participant observations, informal conversations, interviews, and surveys. While both the method and points of inquiry for generating improved impact grew organically from the impact research process, my personal observations of EPI's repeated interactions with each program site were a primary source of information. In other words, it was observation of both the *program* and of EPI's *program implementation* that provided data for the analysis and impact assessment. Additional research performed after my on-site observation aided me to formalize the rough conceptualizations I made in the field.

Ultimately, my rough conceptualizations coalesced into the three systemic constraints discussed in section IV. After providing the final social impact report to EPI, I continued to research the problems within and resulting from EPI's program. I formulated the three systemic constraints outlined in section IV, which subsequently led me to formulate this thesis.

Method of Inquiry

I employed the methodological assumptions of "grounded theory" in my thesis research. Grounded theory represents an inductive process of reverse-engineered, primarily qualitative inquiry (Strauss and Corbin 1998). It follows a research pattern that emphasizes the need to start with a relatively blank theoretical slate, ending with a refined research question rather than beginning with one. This approach emphasizes a problem-based learning approach wherein a solid conceptualization of the problem is formulated prior to devising a more narrow set of hypotheses within the problem context. The problem context that generated this thesis is the

social impact assessment itself. While I will not end with a research question theory to test, I will create a sociological framework that I will apply to EPI's program. In the course of my impact evaluation I discovered areas of interest, perceived patterns, developed theories, and came to hypotheses. I later linked these observations to the conditions needed for EPI's program sustainability. Below you will find a diagram describing the inductive process that led to this thesis. The process was iterative, being refined as I thought through the concepts time and time again. I include with each concept the principle question or questions that led me to the subsequent concept or process.

After considering the major systemic constraints to EPI's success—teacher absenteeism, centralized organizational control, and solution-driven design processes—I attempted to reduce the problem to a single word, which was inefficiency. I asked myself what some of the potential causes of inefficiency were, or if it was even negative. Inefficiency is not undesirable per se. It is only detrimental in terms of 1) opportunity cost, and 2) creation of reliance on outside resources. Opportunity cost relates directly to the particular mission an organization has chosen—EPI's mission in our case—which may be selected and altered by an organization's administrators. A mission is a neutral value until it is applied. Once applied, every program has opportunity costs. Creating dependency among program participants, however, is a form of inefficiency that begs further thought; dependency became the core thread of my research.

I concluded that resource dependence among program participants, no matter what the objectives of a given program may be, must come from a misaligned or incomplete program. If dependency can be created, can its opposite? And what would that be the opposite of dependency? The result of a holistic program design would be sustainability—permanent, or long-term impact. To achieve this requires tools, the ability to use those tools, and the

opportunity to use those tools. I called these three conditions *resources*, *capabilities*, and *opportunities*, each of which was logically explained by theories of capital. Physical capital, human capital, and social capital aligned well with the conditions necessary for sustainable development. These I decided I would test in the familiar context of EPI's work in Africa. I could then use this new perspective to generate suggestions for decreased dependency, or more effective, sustained change.

Theories and research from diverse fields aided me in conceptualizing the planning and assessment framework that is the ultimate product of this thesis. From the medical education literature I learned of problem-based learning (PBL), which has since been accepted more broadly in educational research and further afield. Because learning much like other processes is essentially a problem solving exercise, it is no surprise that the idea of PBL gained traction in fields such as design engineering. Design engineering has adopted and applied PBL to its own functions terming the process "problem-driven design." Because EPI's solution derived from the engineering background of Ben Markham, the fit of problem-driven design with this sustainability assessment was immediately apparent. Besides use in medical education, PBL's application extends to research in organizational processes pertinent to EPI. NGOs, as any other organization, face problems, too. As such, all organizations including NGOs can benefit from problem-driven design processes. Problem-driven design can thus be firmly established in the organizational behavior literature by virtue of its application to NGO formation and performance assessment.

I posited that EPI's inefficiency started before the organization was formally established. Problem-driven design help me realize that there was a mismatch between the solution that EPI generated, and the context it was applied in, and that this mismatch was due to reversed

organization processes. EPI's founder had conceived of a solution, for which he later defined a mission statement, as opposed to creating a mission and determining the best solution to achieve that goal. Further research into processes of problem-driven design led me to literature on innovation both in the field of engineering and in business model generation. The literature fit with what I was seeing at EPI. Because I was operating from a grounded theory approach, I theorized that taking a step back from EPI's solution-driven design would both facilitate an improved understanding of the problem context and generate simpler, more effective solutions toward accomplishing EPI's mission. Utilizing a problem-driven approach would positively impact both the organization and its program. I further posited that by doing so within the framework of theories of capital would facilitate creating sustainable impact.

[Figure 1 about here]

Research Limitations

As a planning and assessment tool, the framework outlined in sections VI and VII intends to facilitate positive outcomes in organizational management, program planning, and assessment. The application of this research analysis to the case of EPI (section VIII) is intended to derive suggestions that can only be tested by applying them. The only way to test my assumptions and recommendations is to convince EPI to adopt one or more of them. Based on the fact that EPI did not apply the suggestions made based on the social impact research, it is my opinion that among the primary limitations to this application is EPI's unwillingness to adopt many, or any, of these suggestions. This limits my capacity to derive and refine new suggestions for improvement based on the necessary conditions for EPI program sustainability.

Section VI: Framing Dependency in Theories of Capital

The introduction to this thesis establishes three categories of necessary and sufficient conditions for sustainability: resource, capability, and opportunity. In this section I explain how

theories of capital relate to the necessary conditions for sustainability. The idea of using theories of capital is not new to international development (Sachs and Warner 1997; Knack and Keefer 1997; Portes and Landholt 2000). Of particular interest to the present study is the Community Capital Framework (Flora et al. 2007; Jacobs 2007) and studies that have employed multiple types of capital in studying changes in the development context (Emery and Flora 2006). Flora et al. (2007) create an assessment framework of seven theories of capital. They include human capital, social capital, natural capital, financial capital, built capital, cultural capital, and political capital. Each of these theories is included in the framework below. Physical capital includes natural capital, financial capital, and built capital. Human capital stands alone, while social capital includes cultural capital and political capital. After giving preliminary attention to the concept of capital, I apply the sociological framework of capital theories to the necessary conditions for sustainability.

Capital

Definitions of economic capital have been discussed and debated for many years (Fisher 1896), but it is not my intention to include the full range of definitions of capital. Adam Smith states that capital should be an asset, or produce revenue (1776), for which definition Fisher (1896) gives the example that a merchant ship is capital, while a yacht is not. Fisher cites various sources from the 19th century in his discussion of capital, citing that some use *capital* as a classification of wealth, such as wealth in production of income, while other consider all wealth as capital (1896). He eventually comes to state that “capital is correlative to income, expenditure, production, consumption, ‘ripening’ of goods in process of production, exports, imports, monetary circulation, etc., “—a rather comprehensive definition (Fisher 1896:534).

Coinciding with the two primary definitions discussed by Fisher (1896), Dictionary.com offers the following definitions: “the wealth, whether in money or property, owned or employed in business by an individual, firm, corporation, etc.,” or “an accumulated stock of such wealth.”¹⁶ Beyond the conceptualizations of capital discussed by Flora et al (2007) further conceptualizations of assets available to humans have included family capital, sexual capital, and organizational capital. Each of these pertains to assets that persons and organizations may use to increase wealth, and as such, each may be relevant to the field of international development and poverty reduction.¹⁷ Below I relate three of these capitals to form a framework for assessing the necessary and sufficient conditions of program sustainability in international development.

Resource: Physical Capital

Briefly stated, physical capital is material wealth, or capital stock, in the forms of durable goods, financial instruments, and other physical assets. For these latter two Flora et al (2007) use the terms financial capital and built capital, respectively. Durable goods—such as weapons, tools, machinery, etc.—enhance man’s ability to perform work. Financial instruments are tradable assets, of which some examples are promissory notes, currencies, and bonds. Durable goods can produce other assets such as crops, cars, and homes, which do not directly aid the owner in the process of production, or useful work. These have use value, exchange value, or both, and may also be termed durable goods. Under the title physical capital I also include environmental resources (Flora et al.’s [2007] natural capital) such as wind, rivers, lakes, and land, although in classical views the latter is regarded as a factor of production, not as capital

¹⁶ See: <http://dictionary.reference.com/browse/capital>, accessed August 2, 2011.

¹⁷ The reader may raise an eyebrow at sexual capital being used for nonprofit work, yet PETA has used the “sex sells” marketing model for a number of years. See PETA’s “Fur? I’d rather go naked” campaign.

inputs, per se (Marx and Engels 1867). I use the term *physical capital* to refer to the physical or tangible resources an agent can utilize within an opportunity environment.

Capability: Human Capital

Early economic theorists like Adam Smith and Karl Marx described the economic value inherent in human beings (Smith 1776; Marx and Engels 1867), but the phrase “human capital” was not coined until the 1950s (Lewis 1954). Human capital, unlike physical capital and social capital, has a simple definition: individual knowledge, competences, skills, health, or values that may be applied to useful work (Becker 1993; Frank 1960; Schultz 1961). Theodore Schultz calls human capital the “useful skills and knowledge” imbedded in humankind (1961:1). Andrew Gunder Frank indicates the importance of the concept by stating that, “Investment in the human factor may well have a higher payoff in terms of increased output than does any other input” (1960:170). Becker emphasizes that health and values are also part of an individual’s human capital (1993).

Although Gary Becker began writing on human capital at the same time as Schultz and Frank, he later went on to describe the concept in terms of specific, or specialized human capital and general human capital (1962; 1993). General human capital is that which may be useful to general productivity, such as literacy and numeracy. Specialized education, such as on-the-job training, Becker calls specific human capital (1962; 1985). These types of human capital impact, albeit in different ways, an individual’s productive capacity. James Coleman, a researcher of social capital, states: “human capital is created by changes in persons that bring about skills and capabilities that make them able to act in new ways” (1988:S100). Human *capability* equates well with this definition of human capital. In relation to my discussion of resources and

opportunities, we can use the following definition for human capital: the capability to apply resources within a specific opportunity environment.

Opportunity: Social Capital

At its core, social capital is a sociological concept that refers to the benefits of human interaction. Though a relatively new area of study social capital has many definitions as it has researchers. That is not to say that the concept, even the phrase “social capital” has not existed for some time. Its first printed use was in the field of education, beginning with John Dewey’s undefined use in “The School and Society” in 1900, and later in Lyda Hanifan’s “The Rural School Community Center” (1916). In 1961 Jane Jacobs first used the term in referencing the benefits of social networks.¹⁸ In Granovetter’s 1973 article, “The Strength of Weak Ties” he argues the individual benefits of different kinds of social relationships. He does not use the term “social capital” although the concept of benefiting from social relationships is the core of his argument that different types of relationships bring different dividends.

Pierre Bourdieu first used concepts relating to social capital in his 1972 book *Esquisse d’une théorie de la pratique*—which was translated, and published as “Outline of a Theory of Practice” in 1977. He later stated clearly that social capital is “the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition” (1992:119).¹⁹ Another key figure in the research of social capital, Robert Putnam, helped popularize the

¹⁸ See page 138 of the cited work.

¹⁹ This expression originated in his earlier French work where he stated that social capital is the “possession d’un réseau durable de relations d’interconnaissance et d’inter-reconnaissance” (Bourdieu 1980:2), and that it is the “agrégat des ressources réelles ou potentielles qui sont liées à la possession d’un réseau durable de plus ou moins de rapports institutionnalisés de la connaissance et de l’identification mutuelles” (Bourdieu 1983:249).

concept of social capital in the 1990s with his books *Bowling Alone* and *Better Together*. His concept of social capital includes concepts such as social solidarity and civic engagement (Putnam 1995).

Researchers have sought to parse social capital into separate forms, thus research in cultural capital, political capital, family capital, sexual capital, bridging capital, bonding capital, and many other forms of relationships-cum-capital. Each in its own right is a form of social capital. All of these variations and definitions lead to the same conclusion: social relations of all kinds are determinants of individual's opportunities to apply their capabilities with the resources at hand. James Coleman lucidly describes social capital this way:

Social capital is defined by its function. It is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors—whether persons or corporate actors—within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that in its absence would not be possible. . . Unlike other forms of capital, social capital inheres in the structure of relations between actors and among actors. It is not lodged either in the actors themselves or in physical implements of production. (1988:598)

Opportunity includes not only the various definitions of social capital—political freedom, social solidarity, societal trust, strength of association with family friends and neighbors, access to others' human capital, etc.—but also the lack of physical force, constraint, or restraint.

Opportunity is favorableness of social environment within which the agent may apply available resources.

Other Factors

A framework including these three categories of capital theories facilitates the analysis of necessary and sufficient conditions for EPI or any other nonprofit organization to operate without generating dependency. Yet, it is important to note that a lack of constraining external

forces and favorable participant choices are also necessary conditions for sustainability. External forces outside human control can negatively affect program success in terms of both impact and sustainability. Atypical weather and natural disasters such tsunamis, earthquakes, and hurricanes can foil the most expertly planned and executed programs. Even under ideal circumstances—and assuming a lack of compulsion, which is a dependent form of relationship itself—sustainability cannot be guaranteed due to participants’ choices to either capitalize on resources and opportunities, or not. To understand those decisions is a topic for further sociological and psychological research, but to understand that it does happen is important to development program implementers.²⁰

Apart from external forces and participant choice, necessary conditions that are beyond the control of participants constitute either a lack of resource, a lack of capacity, or a lack of opportunity. Alternately stated such conditions constitute a lack of physical capital, human capital, or social capital, respectively. If these conditions are not present we can assume a degree of dependency.²¹ Therefore, any program or organization intending sustainable impact must ensure that all necessary conditions are present *and* in control of the program beneficiaries.

²⁰ I assume favorable participant choice—a concept deserving of many tomes, and beyond the scope of this thesis. It is safe to state that even when participants may not choose to participate, that choice may be influenced by preparatory programs. In the case of EPI, however, this is unlikely to be needed. The vast majority of rural Africans recognizes the importance of education, and welcomes programs promoting it.

²¹ Here we consider sustainability and dependency as *gradable* opposites. The reader should question if there must be some degree of dependency, and if so, what is the acceptable degree? The reasonable answer is that the persons or organizations funding the activities decide the degree of acceptable dependency. Because ideal conditions do not exist in the real world let us term this the acceptable degree of *relative dependency*. Conversely we may speak of a desired degree of *relative sustainability*.

Since top-down, centralized approaches typically do not constitute an approach that would not involve potential beneficiaries as stakeholders in decision-making about the program, we may consider them a factor contributing to dependency. The top-down approach taken by some NGOs involved in development has been the subject of criticism concerning the ineffectiveness of NGO programs and strategies in developing contexts (Easterly 2006; Fraser et al. 2000; Stiglitz 2006; Ward et al. 2008). An important aspect of this thesis is a contribution to the critique of top-down approaches to development, with an end goal of improvement in NGO approaches to the design and implementation of development strategies. As organizational structure contributes to program generation, and vice versa, both NGO programs and organizations can benefit from the framework this thesis develops.

Section VII: EPI'S Necessary and Sufficient Conditions

Each of the preceding factors and their associated theories of capital must be considered in its appropriate context. Were this framework applied in the organizational context, rather than the program context, this analysis would appear quite different. Any assessment of impact or sustainability must be done in reference to specific organizational goals. While EPI's goal-setting may be done in reference to standards set by other large or influential development agencies such as the United Nations or the World Bank, the reference point for this sustainability assessment can only be EPI's stated goals.

Let us delineate the necessary and sufficient conditions for the previously described solution, a power-generating merry-go-round, to accomplish the goals designated by EPI. To reiterate, EPI's goals are to "provide educational recreation," to "provide light for children at

school and at home,”²² and to “provide hands-on science kits and teacher training.”²³ I will address each goal referencing each pertaining resource, capability, or opportunity. This process resembles a planning session on the constraints of innovation.

Goal 1: Provide Educational Recreation—Resources

- Recreational MGR is available.
- MGR demonstrates the principles taught in the science kits.

Goal 1: Provide Educational Recreation—Capabilities

- MGR is safe and easy for students to use.
- MGR may be maintained and repaired by program participants.

Goal 1: Provide Educational Recreation—Opportunities

- Village Elders approve EPI’s program.
- School administrators and teachers agree to use the MGR.
- Children are permitted time to play (away from duties, chores, etc.).

Goal 2: Provide Light for Children at School and Home—Resources

- Power conversion, storage, and charging equipment are available and reliable.
- Rechargeable lanterns are available and reliable.
- Sufficient power generation (consistent willingness of children to play)

Goal 2: Provide Light for Children at School and Home—Capabilities

²² EPI intends for the recreational equipment to provide, if possible, the entirety of the electricity used for lighting, and that lighting be used for educational purposes.

²³ I do not address EPI’s supplemental goals—to “provide employment and apprenticeship opportunities for Ghanaians in the fabrication shop” and to “provide educational and service-learning opportunities for US college interns” –because these are natural byproducts (secondary impacts) of the organization’s business model and not part of the direct program impacts. These goals could be analyzed in similar fashion by EPI.

- Participants are able to maintain the power conversion and storage equipment.

Participants are able to maintain the charging equipment and lanterns.

Goal 2: Provide Light for Children at School and Home—Opportunities

- Teachers provide students with homework.
- Students are permitted time to study (away from duties, chores, etc.).

Goal 3: Provide Hands-On Science Kits and Teacher Training—Resources

- Science kits are provided to school instructors.
- EPI personnel assigned to train teachers on the MGR and science kits.
- Curriculum or training available for EPI personnel in training teachers.

Goal 3: Provide Hands-On Science Kits and Teacher Training—Capabilities

- EPI personnel are able to train teachers.
- Teachers able to understand scientific concepts
- Teachers able to instruct students.
- Materials are developmentally appropriate for students.

Goal 3: Provide Hands-On Science Kits and Teacher Training—Opportunities

- Teachers are present to teach.
- EPI curriculum conforms to Ghana national curriculum
- School administrators permit teachers to participate with EPI.

Table 2 lists the implicit assumptions necessary to reach EPI’s explicit goals by using the MGR system. These assumptions are grouped under each of the three necessary conditions for sustainability previously discussed. Where the condition is sufficiently met I mark the item with a “✓”. Collectively, these necessary conditions constitute a sufficient condition for sustainability. Missing or incomplete conditions contribute to inefficiency and dependency on EPI.

[Table 2 about here]

Discussion of Unmet Conditions

It is of note that resources are almost entirely in place. This is not surprising, considering the solution-driven nature of the program design, and that this sustainability assessment pertains to EPI's goals and program solution. The single missing resource was play power, yet EPI personnel could not have determined if sufficient power generation was attainable until after the pilot implementations I studied during my impact assessment.

We see in the capabilities category that, due to the complicated nature of the MGR system, villagers will be dependent on EPI in the eventuality that any malfunction occurs. Although initially the MGRs required constant attention, improvements have been made. I question how long the equipment could last considering the harshness of the implementation context. Even if it were cost-effective for them to do so, villagers currently are incapable of fixing or repairing many of the complicated MGR system components, or sourcing new parts when needed because they do not have the specific human capital to do so. EPI could have simplified its program if, as I remarked in footnote 22, EPI founders were not intent on providing all of the lighting energy through play power. The complicated nature of the solution, I believe, is due once again to the solution-driven nature of the program design. Were the program goals established prior to the solution, simpler means of demonstrating scientific principles and generating lighting would have been found. For example, EPI could have created light-*demonstrating* MGRs (with bicycle generators and LEDs) and hand-crank flashlights for night time study.

As we also see in the capability category, I call into question the developmental appropriateness of the science curriculum generally. I would ask EPI to provide a practical

rationale for teaching rural Ghanaian children about electrical circuits, conservation of energy, centripetal force, magnetism, etc. when the children currently struggle with literacy and numeracy, and few will even complete secondary school. I would not argue that the curriculum would be relevant for those few who attend secondary schools, but these schools are not in the villages where EPI has sought to implement its program. It is also interesting to note that only the older children are strong enough to push the MGR. The younger children both cannot understand the science behind the MGR and don't have the physical strength or stamina to generate significant play power. Perhaps, as I have stated before, the MGR system as a solution is mismatched with the implementation context.

The only opportunities missing are due to teacher absenteeism. As I remark in section IV, teacher absenteeism consists in one of three primary systemic constraints to EPI's success. In addition to tardiness and ineffective time-on-task, teacher absenteeism mitigates the educational value of all of EPI's MGR system components and associated educational materials. For days when teachers are not present at school, students are unlikely to have homework assignments on that day

I cannot help but think that the centralized, top-down approach EPI has taken is the root cause of the mismatch between the solution EPI created and its intended application context. Had EPI's founder reached out to gain multiple perspectives prior to creating and implementing a solution, a fuller problem conceptualization may have avoided unnecessary expense that resulted in minimal impact and low sustainability.

Section VIII: Mitigating Dependency on EPI

Despite present low impact and a high degree of dependency, EPI can improve the impact and sustainability of its programs. This section presents suggestions for adaptations to

EPI's program with the goal of reducing the dependency it generates. I delineate possible solutions to the present inefficiencies of EPI's programs in four subsections. Following the order of constraints and deficiencies raised in sections IV and VI, I first address ways to mitigate teacher absenteeism and alternatives to centralization before discussing ways to create sufficient conditions where such are lacking. I reserve alternatives to problem-driven design until the end of this section.

Mitigating Teacher Absenteeism

Teacher absenteeism, particularly because it is not one of EPI's program areas, is the most difficult of EPI's problems to rectify. I will include only a brief overview of some of the solutions presently being developed or utilized by government agencies and development organizations. If EPI is to address these issues, it would likely be through direct partnership with organizations' whose mission it is to improve teachers' time on task.

Extrinsic incentives are commonly used to motivate teachers. Monitoring and oversight, including the use of tamper-proof digital cameras to verify teachers' presence at school (with non-linear effects on salary), has been effective in Rajasthan, India (Duflo, Hanna, and Ryan 2010). Paying only for verified workdays, or providing bonuses for not missing work, may also be a means of discouraging teacher absenteeism. In *Universal Primary Education in Africa: The Teacher Challenge*, a joint publication of UNESCO and Pôle de Dakar, we note several other positive incentives to decrease absenteeism:

One way of impacting motivation and of reducing absenteeism and attrition phenomena is to provide teachers with attractive career structures. Aside from pay, which is still a major issue for social dialogue, the opportunities open to teachers for promotion and personal and professional development are also important. (2009:165)

Creating ownership and ulterior financial incentives has been the hallmark of the Fundación Paraguaya (Teach a Man to Fish Foundation), which operates trade schools that are

profitable to both students and teachers.²⁴ This model may be adaptable in whole or part to the public schools in which EPI works.

Replacing teachers may also be a viable alternative in some circumstance. For example, some models of the Open Schools movement utilize sophisticated distance learning technology (Perraton 2000). In one of several more traditional approaches, the Lancastrian method (or Monitorial System) places older students in a position of responsibility for passing knowledge on to younger students (Prochner and Karibu 2008).

My own research in EPI's program sites revealed that one of the primary disincentives to teachers coming to work was the commute distance. Because teachers typically came from more urban areas than the ones in which they worked, there are amenities indispensable in their eyes that are unavailable in the rural settings where they work. Rather than in the village in which they worked, teachers would then find housing in the closest small town that had those amenities: potable water, plumbing, electricity, and adequate housing. In interviews several teachers expressed willingness to live in the village in which they worked if some or all of these preferred conditions were present.

Among the days of the week most frequently missed by teachers in EPI's program sites were alternate Fridays: payday. Because of commute times, teachers were unable to access their pay without cutting into work hours. This usually involved not going into work in the morning. Working with government agencies to provide means of payment *at school* would virtually assure attendance on paydays. Payment by ulterior means, or creating programs where proxies or co-signers could access pay in lieu of the teacher may also promise positive results to the problem of teacher absenteeism.

²⁴ See <http://www.fundacionparaguaya.org> (accessed July 15, 2011).

Alternatives to Centralization

A telltale sign of centralization is the dependency it generates (Khôi 1976; Nkansa and Chapman 2006; Samoff 1993). One benchmark EPI may consider as a measurement of both program success and decentralization is the frequency or degree of oversight their programs necessitate. The need for frequent oversight is a benchmark of centralized organizations. Once fully implemented, a good program might need oversight every several months at most. Thus, a program established with constant need of oversight and micro-management would be considered inherently underperforming. In short, centralized decision-making limits valuable perspective while a decentralized approach including multiple perspectives can generate significant value as an organization grows and diversifies.

Authority over the black box could be moved from the school administration, to local village leadership, such as the SMC or the PTA. In conjunction with the transfer of authority from the school to the village personnel, EPI might consider placing MGRs in locations closer to the village center. Village ownership of the project is essential to EPI's long-term success. Having the equipment "closer to home" may help bridge the gap between schools and communities. Though Matthew Colling and I have different opinions about whether or not this would be an effective approach for EPI to meet its goals, trial placements of this kind could easily resolve the debate and determine if this approach has a net positive benefit.

Solution to founder's syndrome. The fundamental solution to founder's syndrome is the decentralization of the decision making process. As mentioned above, capable country and executive directors can effectively manage the day-to-day operations while freeing founders and directors to focus on fundraising and income stream diversification. Yet, an effective plan of action to overcome founder's syndrome must grow organically within EPI. Several elements that

EPI may consider include more detailed employee job descriptions, diversification of stakeholders, definitions of various stakeholders' roles in decision making, and creating a dispassionate board.

Strategic objectives. I suggest a series of impact objectives based both on my knowledge of EPI's mission and on discussions with EPI employees/volunteers. I include these as a separate document in appendix D. The strategic objectives include an expansion and clarification of the goals EPI has presently adopted. Under the heading of each of EPI's missions I suggest several goals, and include both a rationale for those I have suggested, as well as potential success metrics for determining if those goals have been met. By way of example I include several of those objectives: Delegate day-to-day operational decisions to Ghanaian personnel in Ghana; increase parents' educational involvement; provide age appropriate recreation to both primary and junior secondary school students; optimize the cost-benefit relationships of equipment expense to children's play, optimize play time for power output; training materials are both taught in effective ways and useful in teachers' practice; and science education reflects practical value for rural Ghanaian children.

Epistemic breadth. The complexity of EPI's implementation context, in my opinion, requires multiple points of view in order to provide sufficient perspective on the context being addressed. Unfortunately, triangulating local realities through multiple epistemological perspectives both increases methodological overhead as it decreases generalization errors, and as such, must be considered in terms of its costs and benefits (See Rice 2002).

Major epistemological alternatives to positivism include rationalism and constructivism. Rationalism comprehends knowledge as innate and derived through intuition, while

constructivism²⁵ purports that knowledge is created, not pre-existing. Rather than the objectivity that positivists or rationalists may claim, constructivists rely on inter-subjective meaning to define truth. Traditional empiricism, while closely related to positivism, is an experiential approach to knowledge and understanding that relies heavily on the traditional five senses: sight, hearing, taste, touch, and smell. This or other empiricist epistemological approaches may also bring needed insight.

As mentioned previously, epistemic perspectives may compete or conflict with EPI's program objectives. Yet, if EPI personnel can perform program oversight and refinement with a variety of epistemic lenses it will more successfully negotiate the myriad issues that arise when operating within contexts in which alternative epistemic assumptions carry competing promises of future prosperity.

Creating Sufficient Conditions

This subsection lays out a number of solutions to unaccounted-for conditions that are necessary for sustainability. Using the order detailed in Table 2 I include those resources, capabilities, or opportunities necessary for EPI's program to be sustainable. I discuss each unmet condition sequentially and I provide one or more potential solutions. Table 2 shows two unmet opportunities that have been covered by the above subsection on mitigating teacher absenteeism.

Resource: sufficient power generation (consistent willingness of children to play). This resource is not sufficiently accounted for. The willingness of children to play pertains to participant choice, a subject mentioned briefly in section VI. In order to generate sufficient

²⁵ A perspective related to constructivism is interpretive constructionism, which attempts to discern the meaning people attribute to objects and events (Rubin and Rubin 2005:27). Interpretive constructionists attempt to interpret others' lenses but also seek inter-subjectivity (shared meaning).

power to charge the lanterns for one program site, the children would need to play approximately 6 hours. Consistent playtime never approached this threshold, even in the first weeks of MGR installation. Even had the threshold been met, it is likely that playtime would decrease and level off over time due to interest saturation (Caldwell et al. 1999).

EPI has undertaken to supplement power generation with solar panels. According to the founder, however, the long-term feasibility of this option remains low as approximately 25% of these units are lost to lightning strikes each year. A successful effort to supplement power included the provision of additional power-generating playground equipment. I am unsure if this has solved the power shortage either initially or in the long term as the additional equipment post-dated my research contract with EPI.

Many power sources are available for lighting in rural Africa. EPI is constrained, however, by the concept of children generating the energy used to light their evening studies. This is, after all, a significant aspect of their marketing campaign. My suggestion to EPI has long been to use a demonstration light on the MGR itself, which would light when turned (e.g., such as by an inexpensive bicycle lamp generator). A simple capacitor could be installed to make the light more long-lasting. Small battery-powered, hand crank, or solar LED flashlights—any of which can be sourced for about \$1 each—could then be distributed to students for individual and group study. This solution requires less capital investment, is more durable, requires no importation, and achieves EPI's explicit goals.

Capabilities: MGR may be maintained and repaired by program participants; participants are able to maintain the power conversion and storage equipment; participants are able to maintain the charging equipment and lanterns. These three conditions are not met in EPI's present program strategy. The complete MGR system is complex, both mechanically and

electrically. The system includes the MGR, mechanical power transfer systems, electrical generation components, charging and discharging systems, power storage systems, and lighting units. If virtually any part fails on the MGR system, EPI's help would be necessary to repair or replace needed parts. During my impact research I found that program participants were often unaware that electrical parts had failed until EPI personnel or I came to check on the equipment. Mechanical failures, or approaching failures, also went unnoticed.

While capacity building is desirable in international development, a threshold of knowledge and capability must be met before developmentally appropriate steps can further participants capabilities. Due to the extreme complexity of the MGR system, it is unlikely that program participants would have sufficiently advanced resources (e.g. tools), skills, and understanding to facilitate specific training on EPI's equipment.

I do not include in Table 2 the concept of MGR system reproducibility, yet, it is my estimation that a sustainable program will also be reproducible by persons within the implementation context, or at least within the country. This speaks to the capacity of program participants and their social networks to maintain, repair, create, or recreate the program. Many of the MGR system components are not sourced from within Ghana. Importation of essential MGR components includes the gearbox, drive train joints, charge/discharge control systems, lanterns, and batteries. Because of a willingness to import parts for MGR construction, EPI may place equipment in virtually any location with varying costs. However, it is likely their design may be reproducible only by EPI, until such time as another solution is devised.

Alternatives to Problem-Driven Design

Problem-driven design pertains to both developing organizational models and program models to be implemented by organizations. The two may easily blend together while the core

question in both remains models of innovation generation. Business model generation is a private sector concept that has gained recent attention through authors such as Steve Blank, Alexander Osterwalder, and Nathan Furr.²⁶ When evaluating a product (a solution to the customer’s “pain”), the researcher follows the redundant research pattern: hypothesis, test, and pivot. The initial product is the hypothesis, which is brought to the intended consumer for feedback (test). The entrepreneur then pivots, or adjusts the product according to the test feedback, and then repeats the process until the product’s market feasibility is sufficiently proven—it relieves the customer’s pain.

While the ultimate goal of for-profit business is to *create* dependency, relevance to the nonprofit sector is clear: gaining sufficient feedback from the target population is essential to generating an effective solution to the “pain” being addressed. The process is tantamount to an iterative, participatory research agenda and is utilized prior to scaled application of solutions. This process may be applied equally to research agendas in both impact and sustainability or to developing organizational models themselves. Because organizational models

With the movement toward social entrepreneurship, the benefits of business techniques like systematic business model generation are increasingly seen in the nonprofit sector. The hypothesis-test-pivot model may be framed in numerous ways. Kruger and Cross (2006) organize the process in eight steps: 1) gather data, 2) assess value and validity of data, 3) identify constraints and requirements, 4) model behavior and environment, 5) define problems and possibilities, 6) generate partial solutions, 7) evaluate solutions, and 8) assemble a coherent

²⁶ See, for example, Steve Blank’s *The Four Steps to the Epiphany*, or Alexander Osterwalder and Yves Pigneur’s *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*.

solution. While sequential, these steps do not imply linear succession, rather, the need for iterative progression through the eight steps.

There are similar examples from the innovation-generation literature. Heiner Müller-Merbach's Five-Field Analysis (1987)—which I take from Möhrle and Pannenbäcker (1997)—reveals a very similar process which he organizes the following basic category-question pairs:

1. Current State: What does the current situation look like?
2. Resources: Which resources are available?
3. Goals: Which goals shall be fulfilled?
4. Intended State: What shall the future situation look like?
5. Transformation: In which way can the current state be transferred into the intended state?²⁷

We see that Müller-Merbach places the solution generation at the end of the process. Nearly an inverse process is regrettably common. Innovations some development organizations bring to bear on the world's problems are ill conceived, with too little groundwork in problem conceptualization to render them effective (Easterly 2006; Fraser et al. 2006; Mulwa 2008; Stiglitz 2002; Ward et al. 2008). A classic example is what has come to be known as the Tanganyikan Groundnuts Scheme (Rizzo 2006). Many other examples exist; in Dollar and Svensson's study of SAPs (2000) one third of the 220 programs they assessed were deemed failures.

The basic process is clear: the researcher's primary goal is not solving the problem, but of understanding the problem. Problem conceptualization processes are inhibited by top down approaches and facilitated by participatory ones (Mulwa 2008). Fuller problem conception permits solution generation that is simpler and more effective. In EPI's case, a complete understanding of the problem was not realized before a program was operationalized. Below I

²⁷ It is noteworthy that steps 3-5 equate to mission, vision, and strategy, respectively.

illustrate problem-driven design in terms more common to the nonprofit sphere. I outline two seemingly similar approaches that can have dramatically different results. Model 1 demonstrates a problem-centered approach to organizational planning. In the second model we see a solution-centered approach to development.

[Figure 2 about here]

Model 1 quickly attempts to generate solutions. An organization sees a general problem it wishes to address, and quickly moves on apparent solution(s) to that problem. Their program, or applied solution, then drives the mission of the organization and subsequently its vision. Because the program itself becomes the primary goal, impact assessment turns into a measure of the size of the program, or the number of participants involved, rather than the *change* effectuated among the participants and how this change has resolved specific, targeted needs. This is the model EPI appears to have followed.

Alternately, Model 2 begins with needs assessment, implying a research agenda designed to fully comprehend the context where needs may require redress. This technique not only complements participatory, or “bottom up” approaches to development, but encourages their effective use (see Fraser et al. 2006; Lewin 1946; Mulwa 2008). After sufficiently understanding the needs of potential participants and the context in which the organization may operate, the organization describes a vision of the context after operations have been effectuated. Next, the organization formulates a mission, or the specific goals which, when taken collectively, will transform the operational context into the vision the organization has conceived. These goals should be aimed specifically at mitigating the missing *necessary conditions* within the operational context. With this groundwork laid the organization can effectively seek simple, effective solutions to the unmet conditions necessary for the desired change. Finally, an impact

or sustainability assessment can then easily target measures of desired change within a framework of those necessary conditions. This process may be equally applicable to adjusting the organizational structure to maximize the efficient application of solutions devised through the same method.

Section IX: Conclusion

The purposes of this thesis were to 1) generate a sociological framework, or tool, which will facilitate inquiry into the causes of dependency within any international development context, 2) utilize that sociological framework to analyze potential weaknesses in the particular case of EPI's program sustainability, and 3) propose solutions to dependency-generating factors which may be found in EPI's program.

Combining theories of capital with a problem-driven research approach revealed that despite the high cost and innovative nature of EPI's program it remains minimally effective and unsustainable. Kruger and Cross (2006) remind us that creative design is not necessarily good design. Without effective design, neither were the necessary and sufficient conditions for EPI program sustainability present. The result is an unsustainable, low-impact program that requires a high degree of dependency on EPI's continued involvement.

Critiques of the development industry have long held that too much money was and is spent for too little impact in enabling the world's poor to develop physical, human, and social capital assets (Easterly 2001; Easterly 2006; Stiglitz 2002). At the same time programs generated dependency, or an expectation and real need for continued help from these organizations. Poor planning follows incomplete understanding of the necessary and sufficient conditions for sustainable impact in the program context. This may be a result of inverted organizational processes, described in figure 2, where an organization's program dictates its program structure.

The simple difference is found in the difference between solution-driven design and problem-driven design. We have seen the former exemplified by EPI.

Which of an organization's necessary conditions for sustainability, if any, depend on a correct problem conceptualization? The answer, of course, is none. If an organization has sufficient funding and opportunity it can enact programs without consulting its stakeholders. To use resources effectively organizations must not neglect the essential critical thinking involved in *problem-understanding*. I suspect that if EPI had followed a problem-driven research agenda its vision, mission, goals—and ultimately its program—would be significantly different than they now are.²⁸ In light of Nathan Furr's hypothesis-test-pivot business model generation, EPI should consider its present program a tested hypothesis and pivot its program to a more effective and sustainable position in the field of international development. This process may also include an assessment of the organization itself. By utilizing a framework of theories of capital and principles of problem-driven design EPI can progress to a simpler more effective solution.

Through this thesis I posit that when an NGO uses a problem-based, contextually appropriate design it maximizes the chances of helping to create the necessary and sufficient conditions for sustainability. A simple sociological framework utilizing theories of capital permits straightforward conceptualization of the necessary and sufficient conditions for impact sustainability. This framework, which is also supported by critiques of failed development strategies, describes a process for ascertaining the forms of capital necessary for international development in three categories: resources, capabilities, and opportunities. With a more complete understanding of the operational context provided by a problem-driven approach—and utilizing

²⁸ While the idea of finding an African Thomas Edison is fascinating, it is perhaps no better than a crap-shoot for sustained poverty alleviation. Finding an African Thomas Edison is a stated goal of one of EPI's board members.

theories of capital to determine the necessary and sufficient conditions for sustainability—
organizations may decrease resource dependency and improve program sustainability.

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APPENDIX A. SOCIAL IMPACT ASSESSMENT RESEARCH CONTEXT

History of Modern Ghana

Prior to Ghana's independence in 1957, the area was known to the West as the Gold Coast, and was an important source of gold, ivory, iron, and slaves from the late 15th century (Gocking 2005). Historically, the territory that is today's Ghana was the Empire of Asante (Ashanti), an advanced culture of the 18th and 19th centuries (Awoonor 1990). Other peoples, the Ewe, Ga and Fante (Fanti), also lived along the Gulf of Guinea.

In 1482 the Portuguese built the first castle, Fort de San Jorge, on the Gold Coast, which would later boast a significant concentration of European military architecture (Awoonor 1990). While Portuguese, German, and Swedish merchants traded in the Gold Coast over the centuries, the Dutch and subsequently the British had the strongest and most lasting influence in the area (Gocking 2005). When the Dutch left the region in 1874, the British made the Gold Coast a protectorate (Owusu-Ansah 2005; Awoonor 1990).

By the late 1940s moves were being made toward regional decolonization, and in 1957, Ghana became the first sub-Saharan country in colonial Africa to gain independence with Kwame Nkrumah as its first president (Gocking 2005). Nkrumah was educated in the United States and his molding of modern Ghana was strongly influenced by Marcus Garvey, W. E. B. DuBois, and others (Gocking 2005). The country was to be built on principles of freedom, justice, and education for all, irrespective of ethnic, racial, or religious affiliations. These principles fit into the larger pan-African movement of decolonization and self-government; however, the actual execution of the plan left Ghanaians and the world wanting (Gocking 2005).

Nkrumah was overthrown by military coup in 1966, and a series of subsequent coups ended with that of Flight Lieutenant Jerry Rawlings in 1981 (Owusu-Ansah 2005). Rawlings

suspended the constitution, dismissed all officers of the then Third Republic, and ruled as dictator for 11 years before establishing a new constitution and restoring multi-party politics in 1992 (Owusu-Ansah 2005). John Agyekum Kufuor was elected president in 2000 after Rawlings served as president for the maximum constitutional period—two four-year terms. In 2008, John Atta Mills, a former vice president under Rawlings, won the election and became the most recent president of Ghana. He, like his predecessors, has promised sweeping reforms to the country's social institutions including the public education sector which continues to struggle in performance measures, especially in rural areas across the country.

*Education in Contemporary Ghana*²⁹

Ghana presently practices the 6:3:3 system of primary, junior secondary, and secondary education (Baba 2007). Pupils are intended to begin school at 6 years of age (Baba 2007). The school year begins in mid-September and ends in July and comprises three terms: September through December, January through March, and April through July (Baba 2007). Several significant breaks and numerous holidays occur during the school year (Baba 2007).

National syllabi for some subjects are periodically introduced, the most recent of which was implemented in 2008, although many schools, particularly in the rural settings, either have not fully integrated the new texts or have not even received them. Textbooks are typically in English (except for some subjects at the lower primary level), and a great variety of options exist. Schools have autonomy to choose from privately produced texts on the market, although textbooks are in the process of being standardized at a national level (Baba 2007). To the best of my knowledge, science books were officially standardized in 2009, although students and teachers continue to access alternative texts on the private market. The transition to standardized

²⁹ Please note: date of most recent data varies by source.

textbooks will likely aggravate the ongoing lack of available textbooks, particularly in the rural context (Oduro, Dachi, and Fertig 2008).

Baba (2007) informs us that the medium of instruction at the lower primary level (grades 1-3) is usually in a Ghanaian language, but proceeds in English starting from grade four. Both continuous and summative assessments exist, the former constituting 30% of a student's yearly cumulative grade, and end of term examinations comprising the remaining 70%. Teachers prefer to "teach to the test" than to follow broader curricula/syllabi, with social promotion as the norm (Baba 2007).

Public Expenditure on Education

The Human Development Report provides us with information on public expenditure on education in Ghana (2007/2008). Ghanaian educational budgets are tight. Public spending on education as portion of GDP is 5.4%. Of public expenditure on education, pre-primary and primary claimed 39%, secondary and post-secondary (non-tertiary) captured 42%, and tertiary captured 18%. Ghana's Education Index³⁰ was 0.555.

Teacher Training

Lewin provides us with information on teacher training in Ghana (2002). Ghana has thirty-eight teacher education colleges including primary and secondary teacher training. Clinical training is limited. 1998 enrollments were at 20,399 with 1044 full-time lecturers. Student to staff ratio in college is 19.5:1 with a target of 15:1. Annual output of primary teachers was 6000

³⁰ "The education index measures a country's relative achievement in both adult literacy and combined primary, secondary and tertiary gross enrolment. First, an index for adult literacy and one for combined gross enrolment are calculated. Then these two indices are combined to create the education index, with two-thirds weight given to adult literacy and one-third weight given to adult literacy and one-third weight to combined gross enrolment" (HDR 2007/2008:356).

with a total of 63,700 trained teachers in service. Ratio of total number of primary teachers to annual output was 10.6:1, including some secondary teachers. Some 13.5% of teachers remain untrained.

Enrollment

Data on primary enrollments in Ghana show weakly positive trends over the past several decades, increasing from 54% in 1991, to 65% in 2005 (HDR 2007/2008). Primary enrollments totaled 2,290,000 in 2002 (Lewin 2002). Howard White estimates primary Net Enrollment Rates (NER)³¹ based on the Ghana Living Standards Survey, and suggests that official figures are slightly inflated (2005). The human development report cites NER as 65% and NSER at 37%. The combined Gross Enrollment Ratio (GER)³² for primary, secondary and tertiary education is 50.7% (HDR 2007/2008). In Lewin we find that the claimed GER was 79%, although it is likely that these numbers were inflated (2002).

Achievement, Attrition and Gender Parity

According to the 2007/2008 Human Development Report, the adult literacy rate (age ≥ 15) in 2005 was 57.9%. The youth literacy rate (ages 15-24) in 2005 was 70.7%. The percent of 1st graders reaching grade 5 was 63% with a primary age cohort growth rate falling from 4% to 3%. Ghana missed its primary school gender parity goal of 1:1 with a ratio of 1:0.93 in 2005.

*Teacher Absenteeism*³³

³¹ The NER is calculated as the number of children of primary school age in primary school, divided by the number of children of primary school age.

³² The GER is calculated as the number of children in primary school, divided by the number of children of primary school age.

³³ While not included in rates of teacher absenteeism, teacher tardiness also represents a significant constraint on educational attainment and achievement in rural Ghana.

The Ghana Center for Democratic Development estimates overall rate of teacher absenteeism at 27% (2008). Other studies have shown far worse rates by region. In Afram plains teacher absenteeism is an astounding 83.6% (USAID 2005). Based on observations in the five case study villages, the rate of teacher absenteeism appears considerably higher than the national average.

Lighting Options in Ghana

With poor consistency in electricity services across Africa, recent initiatives have aimed to improve available lighting for rural areas³⁴. Energy demand in Africa has surpassed network infrastructure and outstripped supply capacity, leaving many in rural areas neglected. These areas have to depend primarily on smaller, portable lighting options—mostly flash lights with disposable batteries or kerosene lanterns. Market research by the World Bank on improved lighting sources in Ghana, Zambia, and Ethiopia includes predominately solar and battery operated LED devices (rechargeable and non-rechargeable) (World Bank 2008a; 2008b; 2008c).

The benefits of lighting include nighttime security and mobility, as well as the ability to continue work or study after dark. Lighting for education, however, is of a particular concern and was the central focus of the social impact assessment. Children’s learning is often limited to in-school hours due to household and farm responsibilities. Without a lighted venue in which children can do homework at night their learning time is profoundly shortened.

³⁴ Many organizations are attempting to bring alternative lighting sources to rural Africa. A sample of websites from such organizations includes the following: http://www.dlightdesign.com/home_global.php, www.lightingafrica.org, kiteonline.net, www.glenergy.ca, www.solar-aid.org, www.thechildhealthsite.com, www.solarlightforafrica.org, and <http://globalresolve.asu.edu/>

APPENDIX B. PROGRAM IMPLEMENTATION SITE SELECTION PROCESS

Applications to participate in EPI's program were provided to 15 of the 18 villages prior to the MPA volunteers' arrival. Three villages were, in fact, connected in some way to the electric grid although the connections were either malfunctioning or in disuse for a variety of reasons. Over a three-day period MPA volunteers and EPI employees visited each potential project site to collect applications and gain impressions of the villages. The MPA students subsequently suggested five villages for project implementation. The initial applications were quite involved, with requests for information that was overly meticulous or not easily quantified.³⁵ While later EPI interns would develop more sophisticated applications and village selection criteria, the criteria EPI found most significant in the initial selection process were: the number of students at the school, the discipline level of the students and school personnel, the student to teacher ratio, the relationship between teachers and headmasters, the strength/existence of a parent-teacher organization, the distance children walk to school, the commitment level of the teachers, and the community solidarity (a "giving" rather than "give-me" mentality).

In a redundant process, EPI personnel returned to the 15 villages and narrowed those to a short list of eight schools, each of which was visited two or three more times in further attempts to verify previous impressions. Upon the recommendation³⁶ of the Ghana World Bank head of

³⁵ "Some initial criteria the MPAs came up with ended up being not as useful (light level in classrooms, crime in community, etc.). Some of the criteria they came up with was really good. But overall, it ended up being way too involved - too many factors and things that are not very measurable just by asking community members" (email correspondence, Oct 20, 2009).

³⁶ The recommendation by the World Bank representative was intended to engender a sense of desire, responsibility, and ownership for equipment by giving the impression that it was not a guaranteed program.

education, those eight were given applications for the MGR equipment, which included questions about who would maintain the equipment, who would be responsible for monitoring equipment use, how lanterns and lantern leaders would be assigned. These eight villages were then narrowed to a final five, including three of the MPAs' original suggestions. EPI's executive director considered the initial (MPA) selection process a learning opportunity where final village selection was essentially based on gut impressions.³⁷

In addition, villages were intentionally chosen for their linguistic diversity: two villages are Ga-speaking, two are Dangme-speaking, and one is Ewe-speaking. Although all include significant diversity in religious affiliation, four are primarily Christian with the remaining village comprised of significant animist and Muslim populations. Two villages are in the mountains, one in low woodland areas at the foot of rocky outcroppings, and two in grasslands. The villages also vary in size from several hundred to more than one thousand people.³⁸ I include in Table 3 a simple description of the program site demographics and lighting availability.

[Table 3 about here]

³⁷ "I think most of their recommendations were 'gut' feelings rather than using their extensive evaluation sheets anyway" (email correspondence, Oct 20, 2009).

³⁸ Detailed summaries of each village were included as Appendix A of the Social Impact Assessment Report provided to EPI.

APPENDIX C. SOCIAL IMPACT ASSESSMENT METHODS AND APPROACH

Data Collection Methods

Prior to notifying villagers that their school would receive an MGR, I lived in the village to identify social and political structures, socio-economic conditions, and environmental factors affecting education programs. Although primarily qualitative data were collected, some quantitative data were collected as well, including surveys of population, age distribution, family size, school demographics, and quantity of lighting options available in each village. My methods included participant observations, informal conversations, interviews, and surveys. The villagers were at times key sources, informants, respondents, and/or subjects depending on the type of communicative event (Campbell and Russo 2001).

In the initial ethnographic stage of research I made formal contact through EPI with village elders, Parent-Teacher Association (PTA) chairmen, and School Management Committee (SMC) members. After establishing places of residence and terms of financial compensation, I set a time to return and reside in the village for a time. While I was introduced by EPI personnel, no indication was given that I was associated with their project, or had any goods or services to offer myself. This period of pre-installation observation was also intended to engender confidence and trust. This stage comprised a descriptive study of local social patterns, including cultural, economic, and political elements (Gay, Mills, and Airasian 2006). This information was compiled into village profile documents for each project locale.³⁹

Each of the community profiles contains details under the following headings: village contact information, school contact information, location, driving directions, population (persons and households), languages, ethnicities, education (available facilities, number of grades, number

³⁹ Also found in Appendix A of the Social Impact Assessment Report provided to EPI.

of students), housing (type and number), modes of transportation, festivals, holidays, taboo days (non-work days), religions, community social organization, (Chief's status, land ownership and decision-making power, modes of village communication, community project organization), member-benefit groups, (SMCs, PTAs, funeral associations, women's association, weeding associations, farmers' co-ops, etc.), diet, health and sanitation (customs and facilities), occupations, economic activities, gender roles, technology, survey of population and lighting use (population in each housing cluster, number of kerosene lanterns, number of "bobos" or "atsomeh"⁴⁰, number of LED torches, number of "bulb kedaka"⁴¹, other power/lighting sources), daily activities, previous NGOs working in the area, and other notes on culture, language, etc.

Informal interviews and observations captured perspectives of the multiple stakeholders. Because I was working without official translators, my information came from or through key informants. Some quantitative data were gathered from participating schools with the intent to prepare for longitudinal studies of educational impact. This data included any available grade books and student fee registers, although only one school—Katapor—had significant records. In addition, with the exception of one project locale I administered population surveys in addition to assessing the quantity and distribution of lighting resources.

Interviews are used both for understanding meanings and for describing events and processes (Rubin and Rubin 2005). Understandings of general conditions were obtained through open-ended, informal conversations that were free-flowing, while more specific knowledge required semi-structured or highly structured questions (Coe 2001; Rubin and Rubin 2005).

⁴⁰ "Atsomeh" is the word for a kerosene lantern, like a "bobo," in various dialects.

⁴¹ A type of ad hoc LED light source constructed from broken flashlights, usually involving a home-made battery holder (e.g., bamboo tube with nails as contact points) wired to an unprotected LED.

While impact assessments often address factors related to either the environment or social change in general, several social impact assessments have targeted technologies or programs that are in ways similar to EPI's. One such impact assessment, performed in 2006 by Practical Action Consulting (PAC), addressed technological dissemination from the Center for Innovation and Technology Transfer (CITT) operating under the umbrella of the Kigali Institute of Science and Technology in Rwanda. Specifically, the CITT studies looked at integration of biogas reclamation programs and found that uptake and impact were both high. PAC used several methodologies similar to the present study including discussions with participants both individually and in focus groups, and the use of key informants.

In 2008 Chapungul assessed the Elephant Pump clean water project in Zimbabwe. Chapungul's primarily quantitative assessment found that women were traveling shorter distances and using more and cleaner water. In order to address local views and contextual factors relative to the Elephant Pump project, Chapungul also used a participant surveys, interviews, public meetings, and focus groups (2008).

LOG Associates' environmental and social impact assessment of a proposed 400kv transmission line for the Kenya Power and Lighting Company (KPLC) also used qualitative methodologies including review of documents, consultative meetings (e.g., focus groups), and individual interviews with what they term "project affected persons" (LOG Associates 2009:4). Not surprisingly, LOG Associates' study found risks for negative impacts of the proposed project within reasonable limits and suggested the project continue.

Ahmadvand and Karami (2009) also used social impact assessment methodologies to study the impacts of floodwater spreading in Iran, although their study different from the present study in significant ways. The most significant difference was that Ahmadvand and Karami

conducted a comparative study of affected and non-affected villages while my assessment of EPI's work was intended to examine conditions in a pre- and post-project design. Indeed, comparison with other villages would have highly complicated the endeavor considering the great diversity in the proposed project sites. Still, Ahmadvand and Karami collected similar information to our own—general agricultural, cultural, and socio-economic conditions –and employed similar methods, including both interviews and questionnaires.

Research Limitations

Upon arrival in Ghana I learned that students were on vacation from the beginning of August through mid-September. An unfortunate combination of miscommunication with EPI and the rapid execution of the research timeline combined to delay observation of in-school MGR installations. Additionally, my assumption included that five MGR systems were already built and prepared for installation. In actuality, no construction had begun on the latest prototype, major mechanical changes were still being discussed, and essential imported parts were yet to be cleared through customs.

With delays in EPI's installation target dates, much of my research took place in an interactive context that involved Matthew Colling and I not only observing the engineering and installation process, but also being active participants in seeking out its success. As the program implementations were not immediately ready for observation, Matthew and I stepped in and out of the role of action researcher, making unbiased, objective observation more difficult. Some researchers have also critiqued participatory approaches to development (Clever 1999).

The fact that research locations include ethnic, linguistic, religious differences makes cross-village assumptions difficult. I hope, therefore, to provide general insights applicable to a broader rural setting. My assumption is that educational change is best understood when

attention is paid to individual school contexts and, therefore, solutions must be geared to local circumstances (Khamis and Sammons 2007; Arum 2000).

In addition to the researcher bias, discussed below, *participant* bias or *subject* bias can impact perceptions of EPI's success (Campbell and Russo 2001). In my own opinion, perceptions of a lack of success may have an equally negative influence on desired impacts as that of ineffectual programs. Selecting participant interviewees would ideally include those with experience, knowledge, and/or a diversity of perspectives (Rubin and Rubin 2005:65-67). As Rubin and Rubin argue, they become my conversational partners, leading to reciprocity and self-revelation. With this approach in mind, a linguistic research limitation surfaced which hindered my capacity to access such persons—I was only able to converse with English-speaking villagers. As I conversed with only a subset of the village population, the “observer effect” has certainly influenced many of my findings (Gay, Mills, and Airasian 2006:424). On the other hand, the corresponding effect of the previously mentioned delay in installation was a more thorough observation of pre-program village life as well as the establishment of long-lasting village relationships.

Referential bias and the problem of researcher awareness—otherwise known as researcher bias or field worker's bias, or more generally by the term “subjectivity”—are partially mitigated by triangulation, or having multiple observers (Campbell and Russo 2001:293,301). Although researcher bias is perhaps the most difficult to diminish, I both recognize the complex issues it presents and that meaningful knowledge can be constructed from one or a combination of subjective viewpoints (Mehra 2002). My research directive included relatively general goals alongside the mandate to provide suggestions for program improvement. I was not provided well-defined objectives, strategies, milestones, or other quantifiable success measures. My

mission was, generally, to perceive impacts and to judge their merits. While framed within EPI's stated goals, my determination of EPI's successes or failures are, therefore, my own subjective views and do not necessarily represent those of EPI.

APPENDIX D. PROPOSED STRATEGIC OBJECTIVES AND SUCCESS MEASURES

I include the objectives below not as a comprehensive list, but as suggestions for EPI to consider. The objectives and success measures proposed below are intended to help EPI focus on and attain greater degrees of success in its three overarching goals:

- 1) Provide educational recreation
- 2) Provide light for children at school and at home
- 3) Provide hands-on science kits and teacher training.

I organize the objectives into four sections, beginning with “organizational objectives” followed by the three goals above, in respective order. The objectives formulated, relate directly to EPI’s missions and processes. I have attempted to avoid addressing non-manipulable secondary impacts of the processes involved in reaching those goals. In addition, as much as possible we propose objectives that are specific, measurable, attainable, results-oriented, and time-bound (S.M.A.R.T.).

Organizational Objectives

- 1) Establish highest possible degree of material sourcing and production in Ghana.

Rationale: The overall goal of having the highest degree of material sourcing and manufacture take place in Ghana is the best manipulable goal for local secondary impact in employment and job training. This objective also facilitates the decentralization of decision-making.

Success Measures: Cost ratio of materials sourced in-country versus out-of-country. Cost ratio of personnel requirements in-country versus out-of-country.

Note: The original supplementary objective to “provide employment and apprenticeship opportunities for Ghanaians in the fabrication shop” is a secondary impact of EPI’s activities and not explicitly managed by EPI itself. Insofar as EPI utilizes a fabrication subcontractor,

employment and apprenticeship opportunities exist a priori. This secondary impact is completely within the hands of the subcontractor and should not be included in EPI's objectives.

2) Utilize US college interns for tasks and processes that are not replicable in Ghana.

Rationale: This is an efficiency measure related to EPI's ability to outsource costs and labor. Yet, such outsourcing should not compromise decentralization processes to Ghanaian personnel.

Success Measures: Volunteer labor value as a portion of overall labor value. Alternately, volunteer labor hours as a portion of overall labor hours.

Note: The original supplementary objective to "provide educational and service-learning opportunities for US college interns" appears unrelated to both EPI's nonprofit purposes and its methods for achieving those purposes. Rather, that objective relates to the secondary impact of EPI outsourcing research and development processes.

3) Delegate day-to-day operational decisions to Ghanaian personnel in Ghana. Rationale: This goal represents decentralization of decision making. If in-country personnel cannot or "should not" manage EPI's operations, the organization is only creating dependency with an unsustainable solution.

Success Measures: Number and kind of decisions are decreasing among US-based personnel. US personnel are spending less time on day-to-day operations. Ghanaian personnel are being trained on, and proficient in all aspects of EPI's operations.

4) Increase parents educational involvement. Rationale: This objective represents a decentralization of educational involvement from the schoolhouse to the village as well as an expansion of EPI's educational impact.

Success Measures: Parents are invited and attending study group sessions.

Objectives for Mission #1: Provide Educational Recreation

1) Provide age appropriate recreation to both primary and junior secondary school students. Rationale: This objective implies differentiated needs of the multiple age groups served by EPI.

Success measures: Programs reflect the needs of the different physical and developmental capacities of the children EPI intends to serve.

2) Utilize educational recreation and associated equipment to demonstrate scientific principles. Rationale: This objective refers to the direct educational link between the developmentally and contextually appropriate science curricula and the play activities promoted by EPI.

Success measures: Science curricula reflect principles easily distilled from children's play. Concrete principles are taught and understood.

Note: This objective does not imply that any or all of the lighting for education (below) be provided by or through children's play—power being converted to electricity.

3) Optimize the cost-benefit relationships of equipment expense to children's play. Rationale: Utilizing the least expensive play equipment—which still demonstrates the principles EPI desires children to understand—is an essential aspect of expending limited funds in the most impactful ways (within EPI's mission).

Success measures: Equipment development reflects 1) the simplest form of play related to given scientific principles, and 2) the least expensive form of play related to such principles.

Note: This could imply NOT utilizing EPI's play equipment for power output. Rather, equipment could be used simply for demonstration of principles on a significantly smaller scale.

Objectives for Mission #2: Provide Light for Children at School and at Home

1) Optimize play time for power output. Rationale: More fun, for more kids, equals more power. This creates a better cost-benefit ratio for village lighting. This may include a diversification of children's play time. With fewer children on the equipment over longer periods of time both play time and power output may be maximized.

Success measures: School/play schedules represent an optimized balance between learning and play with different groups given opportunities to play at different times. Bicycle counters could be used to determine rotations over a period of time, and power output could be measured periodically from the main battery. The corresponding ratio could be used as an EPI benchmark.

2) EPI equipment provides sufficient lighting for all educational needs at school and home. Rationale: EPI should find a way to completely fulfill demand for education-related lighting.

Success measures: Demand for education related lighting is measured. Programs are designed to meet those specific needs, and in the places. Lighting solutions are provided.

Notes: If "school" is going to be included in EPI's mission statements, programs should be created to be applicable at the school as well. EPI may consider removing the word "school." Also, EPI may consider eliminating from its implied mission the need to produce all or some of the lighting energy from the MGR. It appears—both from EPI's use of additional solar panels and from the overall cost of a power-generating MGR—that this solution is not cost effective compared with alternative and equally educational alternatives.

Objectives for Mission #3: Provide Hands-on Science Kits and Teacher Training

1) Mitigate teacher absenteeism. Rationale: When teachers aren't in school, neither science kits nor teacher training are of any use, whatsoever.

Success measures: Rates of teacher absenteeism are decreasing. Specific rates of tardiness may be set as goals in light of present rates.

2) Mitigate teacher tardiness. Rationale: When teachers aren't in school, neither science kits nor teacher training are of any use, whatsoever.

Success measures: Rates of teacher tardiness are decreasing. Specific rates of tardiness may be set as goals in light of present rates.

3) Training materials are both taught in effective ways and useful in teachers' practice. Rationale: Training materials should represent the needs of the population being served, not the ideals of the culture or institution providing training and materials. In addition, applicable materials should be presented in a developmentally appropriate way to the teachers in EPI's program sites.

Success measures: Teachers are able to understand the materials and methods EPI hopes to teach. The materials are applicable to the national curricula those teachers are required to teach. The teachers can easily include the materials in their normal teaching curricula/timeline.

4) Science education reflects practical value for rural Ghanaian children. Rationale: Children should be taught principles and skills that can easily translate into better and more productive lives. Otherwise, the real value of the time utilized for such education might be better used in the farms or in other village activities.

Success measures: Children can understand and apply their education to their lives. Such educational application has an overall positive impact on the children's lives. The more frequently such principles are applied, the better.

Table 1. Qualitative Nature of Basic Patterns Observed in Five Villages

Desirable	Neutral	Undesirable	
		<i>Acceptable</i>	<i>Unacceptable</i>
<ul style="list-style-type: none"> • Periodic lighting available for education • Children studying in groups at night when lights were working • Temporary increase in teacher survey of student activities • Teachers who are in villages are able to plan lessons at night • One teacher using lantern to prepare lessons (Koni Kablu)* 	<ul style="list-style-type: none"> • Study groups not meeting when lanterns are out of power. • Students not arriving as early to school to do or copy homework (Adenkrebi) 	<ul style="list-style-type: none"> • Children dizzy, nauseated (vomiting) after initial exposure to MGR • Temporary parental concern and skepticism • Leaders initially unable to charge lanterns regularly (Katapor and Adenkrebi) • EPI disappointed initial expectations Distrust was overcome with additional EPI efforts (Minya) • Reversion to previous homework habits when lanterns not working (Minya) 	<ul style="list-style-type: none"> • Not all study groups meeting • Parents who were formerly studying with their children ceased studying with children • Children not generating sufficient power to recharge lanterns. • Child boredom with equipment (Dedenya) • Conflict between private school (where the prototype MGR was located) and nearby public school (Essam)

* Non-general observations include specific project implementation sites in parentheses.

Table 2. Analysis of Conditions Necessary for EPI Program Sustainability

Condition Exists	Necessary Conditions
<i>Resources:</i>	
✓	Recreational MGR is available.
✓	MGR demonstrates the principles taught in the science kits.
✓	Power conversion, storage, and charging equipment are available and reliable.
✓	Rechargeable lanterns are available and reliable.
--	Sufficient power generation (consistent willingness of children to play)
✓	Science kits are provided to school instructors.
✓	EPI personnel assigned to train teachers on the MGR and science kits.*
✓	Curriculum or training available for EPI personnel in training teachers.*
<i>Capability:</i>	
✓	MGR is safe and easy for students to use.
--	MGR may be maintained and repaired by program participants.
--	Participants are able to maintain the power conversion and storage equipment.
--	Participants are able to maintain the charging equipment and lanterns.
✓	EPI personnel are able to train teachers.
✓	Teachers able to understand scientific concepts.*
✓	Teachers able to instruct students.*
--	Materials are developmentally appropriate for students.
<i>Opportunity:</i>	
✓	Village Elders approve EPI's program.
✓	School administrators and teachers agree to use the MGR.
✓	Children are permitted time to play (away from duties, chores, etc.).
--	Teachers consistently provide students with homework.
✓	Students are permitted time to study (away from duties, chores, etc.).
--	Teachers are present to teach.
✓	EPI curriculum conforms to Ghana national curriculum.*
✓	School administrators permit teachers to participate with EPI.

*Some aspects of EPI's third mission are yet to be fully implemented. These conditions I assume to be met.

Table 3. Summary of Demographics and Lighting Availability by Program Site

Village	Language/ Ethnicity	Population (Households)	Average Household Size	Primary/ Secondary School Population	Average Number Fuel-based Lighting Devices per Person	Average Number of Electrical Lighting Devices per Person
Adenkrebi	Ga/Ga	~500 (NA)	NA	NA/NA	NA	NA
Dedenya	Dangme/ Ada and Ningo	1137 (140) 442* (45*)	8.1 9.8*	225/47	143	90
Katapor	Ewe/Ewe	961 (166)	5.8	133/79	632	219
Koni-Kablu	Dangme/ Ada and Ningo	433* (74*)	5.9*	159/0	133	156
Minya	Dangme/Dangme	240 (40)	8	96/0	99	136

**Estimations were made from samples I collected. Other figures are derived from censuses I administered or, in the case of Dedenya, from official documents.*

Figure 1. Inductive Research Process

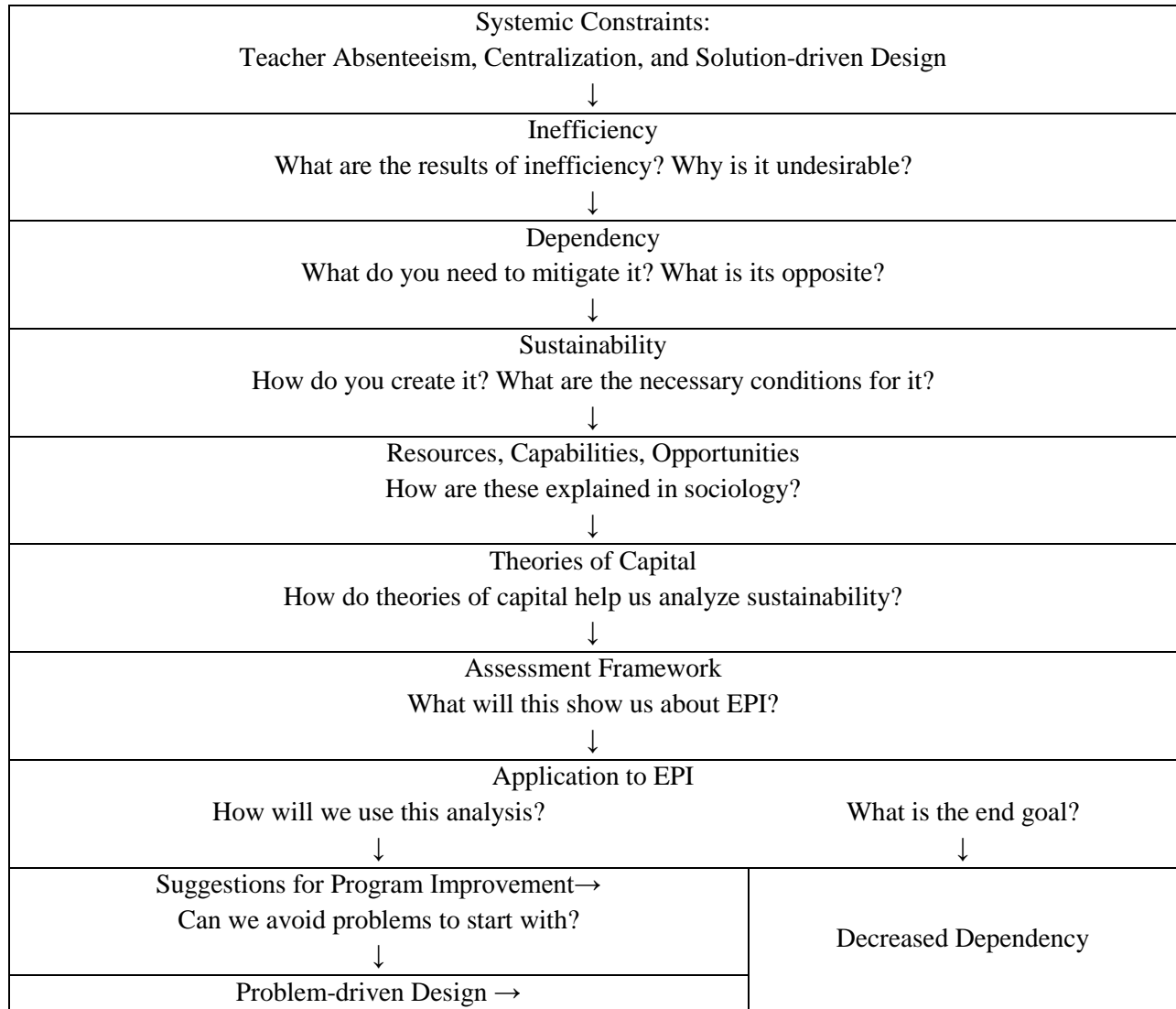


Figure 2. Solution-Centered versus Problem-Centered Planning

