Application of capital flow analysis to identify mechanisms for human capacity building in IS projects in a developing economy

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ABSTRACT
Success in human capacity building in IS[1] projects in developing economies is crucial in the face of myriads of challenges. Specifically lack of skills, failures of retaining, lack of producing quality and competent personnel, brain drain, low level of IT literacy, etc. remain significant obstacles. In this study, a model is proposed, as alternative tool, that draws on ecosystem theory, the application of capital flow analysis and critical realist data analysis framework, to identify mechanisms to develop an understanding of human capacity building in IS projects. Cases were taken from university-wide network and software development initiatives in Addis Ababa University, Ethiopia, and from continued efforts that realized the Ethiopian Educational and Research Network (EthERNet). Data collection was via interviews, observation and archival data. The analysis of the cases demonstrates the value of capital flow analysis to inform IS project managers for stimulating initial and continued human capacity building in a developing economy.

Keywords
Ecosystem theory, capital theory, human capital, human capacity building, capital flow, IS project

1. INTRODUCTION

Economic development is increasingly linked to a nation's ability to acquire and apply technical and socio-economic knowledge, and the process of globalization is accelerating this trend. Comparative advantages come less and less from abundant natural resources or cheaper labor, and more and more from technical innovations and the competitive use of knowledge. Today,

[1] While IS signifies Information System, IS, IT and ICT are also used interchangeably in this work

economic growth is as much a process of knowledge accumulation as of capital accumulation (Salmi, 2005).

Africa is experiencing profound shifts which all affect the building of human capital. With a young and rapidly growing population, Africa' demographics are the most dynamic in the world. Economically, African countries have been growing by 5-8% on average, the private sector has a much larger presence in Africa than ever before, and Africa's aid architecture is shifting, with new partners such as China and India emerging. Technologically, Africa has been benefitting from a shift of the technological curve, leapfrogging access to information and communication (AfDB, 2011). The importance of information systems and technology for national and institutional development has long been recognized by developing economies. But its adoption has faced a number of problems owing to lack of funds (Edet, 1996). Many other reasons have also been put forward for explaining why it is difficult to achieve easy, successful or quick implementation of IS projects. These include management of human resources, getting the right people on the project or getting the team to function (Cavaye and Christiansen, 1996). Lack of IT capacity building also remains a significant obstacle to the successful implementation of IT projects in developing economies (Adam and Urquhart, 2007). Generally, developing economies lack capital in its various key forms, namely, economic, social, symbolic, organizational, and human capital (Dean, 2007).

Capacity building is a complex notion – it involves individual and organizational learning which builds social capital and trust, develops knowledge, skills and attitudes and when successful creates an organizational culture which enables organizations to set objectives, achieve results, solve problems and create adaptive procedures which enable it to survive in the long term (DFID, 2008).

Success in human capacity building in IS projects in developing economies is crucial in the face of myriads of challenges. Specifically lack of skills, failures of retaining, lack of producing quality and competent personnel, brain drain, low level of ICT literacy, etc. remain significant obstacles. However, human capacity building in IT (IS) projects is under-researched issue (Adam and Urquhart, 2007). Experiences show that practitioners and academics alike still know little about what mechanisms are effective and which factors influence human capacity building in IS projects in developing economies. Studying mechanisms for human capacity building in IS projects in developing economies is generally lacking. This study proposes a model, as alternative tool, that draws on ecosystem theory, the application of capital flow analysis and critical realist data analysis framework, to identify mechanisms to develop an understanding of human capacity building in IS projects by considering cases from a developing economy.

Given the critical nature of capital for IS projects and operations in developing economies, analyzing the capital flows (mechanisms) that occur in the development and implementation of IS (IT) is a way of diagnosing continued successful outcomes or failure and predicting what capital flows (mechanisms) that are necessary for sustainable human capacity building success in an IS.

The next section discusses briefly on ecosystem. Section three discusses the main concepts related to capital flow analysis including the capital typology. Section four deals with the critical realism approach. Section five shows empirical understanding on sample case analysis. Section six presents the lessons learned from the cases analyzed including the presentation of the general model for identifying mechanisms for human capacity building. The last section shows the conclusions and implications of this piece of work.

2. ECOSYSTEM

An ecosystem is defined as "a dynamic complex of plants, animals and microorganism communities and the nonliving environment, interacting as a functional unit. Humans are an integral part of ecosystems" (Jørgensen, 2002). Ecosystems are a different way of conceptualizing a problem space that is emergent and organic (Hasan and Kazlauskas, 2009). An ecosystem "involves the circulation, transformation, and accumulation of energy and matter through the medium of living things and their activities" (Wynn, 2007). There are three key components in this definition: the living things, the energy and matter they conduct, and the activities they perform. The primary energy in biological ecosystems is sunlight, some of which is converted into organic material by primary producers (plants). All other organisms in the ecosystem are consumers that feed on the primary producers or on other lower-level consumers.

Business researchers have begun to adopt a biological ecosystem model in the analysis of business relationships and strategic decision-making (Adomavicius et.al, 2006). Managers and academics are coming to recognize the value of the ecological metaphor for understanding the complex network of business relationships within and across industries (Wynn, 2007; Adomavicius et.al, 2006; Hasan and Kazlauskas, 2009).

By considering the technology ecosystem as an interrelated set of technologies and environmental forces (especially social and technical forces) that may impact innovation, development, and adoption, a manager can more successfully identify factors that may impact innovation, development, and adoption of new technologies—and ultimately the success of the business activities that use the innovations (Adomavicius, Bockstadt,Gupta & Kauffman, 2006).

Metaphorically applying the definition of ecosystems to organizational ecosystems such as technological systems, we can see that a similar set of three components arise: actors, capital resources, and interactions among them. The actors in an organizational ecosystem are typically individuals and organizations. In turn, these organizations are composed of individuals. Owing to the nature of ecosystems as open systems with highly flexible boundaries, this set of actors can be fluid and dynamic. For instance, an open source project ecosystems allow participation by nearly anyone who wishes to contribute (Wynn, 2007). While, organizational projects are generally constrained to authorized personnel, the ecosystem perspective remains valid because of the fluid and dynamic nature of participation and capital flows over the duration of a project.

IS projects by their nature consist of simple units (individuals) and complex units (combinations of individuals in various forms) where members of each unit are capable of performing

distinguishable functions and sustaining relationships. For example we find individual or group of project managers, individual developer or group of software or network developers, designers, implementers, testers, users, vendors, sponsors, etc. Their relationship can be of *symbiotic* – living together usually to their mutual advantage, *parasitic* - especially when one set of units consumes an abnormally large portion of the benefits particularly scarce benefits such as financial capital produced by the members of the system, *comensalistic*, where capital of some members of the ecosystem increases while there is no any effect on others, etc.

3. CAPITAL FLOW ANALYSIS

This research applies the biological ecosystem analogy to the task of understanding the dynamic nature human capacity building for IS projects. We specifically focus on developing a model to investigate mechanisms for human capacity building base on a stepwise framework for critical realist data analysis and capital flow analysis that provides insights to IS project and senior managers who oversee IS projects. In our case, capital flows in their various forms are akin the sun shining on a natural ecosystem. Capital flows are the "energy" that drive organizational ecosystems and, if successful, convert capital from one form to another (e.g., using economic capital to educate people and create a stock of human capital).

In this work, capital is considered as a medium of exchange and storage that enables a given unit (member of ecosystem) to both contribute to the ecosystem and derive benefits as a result. It is this role as a medium that capital enables the specialization of units/members within an ecosystem and the interdependence between these units. By exchanging the surplus outputs created as a result of one unit's production for the surplus outputs of another unit. As larger numbers of units contribute to the ecosystem, each with different production functions and consumption requirements, a richer set of exchange relationships and capital paths is established to match the increasingly complicated interdependencies. Thus, ecosystems can be explained via examination of the flows and possession of capital between the various units that compose them (Wynn, 2007).

Table 1: Capital Typology, adopted form Wynn (2007)

Capital	Definition
Economic	Includes financial, physical, and manufactured capital resources.
Social	The ability of an individual or group to capitalize on the social connections that are available; includes structural, cognitive, and relational dimensions (Nahapiet and Ghoshal 1998). (See also: Adler & Kwon, 2002; Bourdieu, 1985; Coleman, 1988; Lin, 2001; Nahapiet&Ghoshal, 1998)
Symbolic	The amount of honor or prestige possessed within a given social structure; includes aspects such as reputation, legitimacy, authority, status, and rank (Bourdieu 1985).
Human	Skills, knowledge, and abilities of an individual thatcan be used to generate income or other useful outputs (Becker, 1993).
Organizational	Institutionalized knowledge and codified experience stored in databases, routines, patents, manuals, structures, etc.; essentially, the knowledge, skills, and information that stays behind when an organization's people go home at night. (Youndt, Subramanian, and Snell 2004)

A capital flow analysis refers to the investigation of the acquirement or availability of capital by units in the ecosystem (individuals or group of individuals), conversion of one form of capital to another, combination of one or more of the stated capital types, and distribution of the same throughout the ecosystem by the members. It mainly looks at the capital contributions made by members of the ecosystem toward specific set of aims, their productivity that result from the contributions, as well as the mechanisms necessary to harness them into coherent package.

Thus, the first step toward understanding the operation and capital flows in an ecosystem is to identify the units involved, the roles each plays in the functional outputs generated by the organization, and the norms, etc. affecting the relationships between the various roles toward the creation of the necessary functional outputs. An understanding of the structure and organization of these exchange relationships precedes the investigation of the capital flows and productivity within the ecosystem (Wynn, 2007). See also in section 4 the stepwise framework for critical realist data analysis.

4. CRITICAL REALISM

As formulated by Bhaskar (1975, 1998) and extended by others, cited by Wynn and Williams (2012), and Bygstad and Munkvold (2011), modern critical realism is positioned as an alternative to the positivist and interpretivist paradigms, and leverages elements of both to provide new approaches to developing knowledge. Specifically, critical realism acknowledges the role of subjective knowledge of social actors in a given situation as well as the existence of independent structures. Bhaskar (1998) and Archer (1995) in assert that critical realism combines realist ontology with an interpretive epistemology, and although a real world exists, our knowledge of it is socially constructed and fallible.

The basic assumption of critical realism is the existence of a real world independent of our knowledge of it. Reality is conceived as being stratified in three domains; the real, the actual and the empirical. The *real* domain consists of structures of objects, both physical and social, with capacities or behavior called mechanisms. These mechanisms may (or may not) trigger events in the domain of the *actual*. In the third layer these events may (or may not) be observed, in the e*mpirical* domain. Thus, structures are not deterministic; they enable and constrain events (Wynn and Williams 2012 and Bygstad and Munkvold 2011).

Critical realism (CR) based research methodologies offer researchers new opportunities to investigate complex organizational phenomena in a holistic manner. CR-based research can effectively respond to recent calls that identify the mechanisms which connect "chains of indeterminate events and complex interactions". This allows researchers to develop and support in-depth causal explanations for the outcomes of specific socio-technical phenomena that take into account the breadth of information technology, social, organizational, and environmental factors which may have played a causal role in their occurrence (Wynn and Williams, 2012).

Mechanisms are at the center of a critical realist methodology. At a general level a mechanism is a causal structure that can trigger events (Bhaskar 1998) as cited in (Bygstad and Munkvold

2011). For identifying mechanisms Bygstad and Munkvold (2011) proposed a stepwise framework for critical realist data analysis shown as follows (For more details see Bygstad and Munkvold (2011). This study also uses this framework to identify mechanisms based on capital flow analysis which is described earlier in section 3.

Step 1: Description of events
Step 2: Identification of key components
Step 3: Theoretical re-description (abduction)
Step 4: Retroduction: Identification of candidate mechanisms
Step 5: Analysis of selected mechanisms and outcomes
Step 6: Validation of explanatory power

In this study capital flow analysis is applied in step 3, step 4 and step 5. For limitation of time step 6 is not undertaken.

Cases were considered for this study. Data collection on selected cases for this work was via interviews, observation and archival data, in order to carry out the identification of events, components and mechanisms based on the aforementioned critical realist data analysis steps and using the capital flow analysis approach. The summary of data collection methods is presented as follows.

Methods	**Activities**
Observation	Personal participation in the process of AAUNet implementation and in the design of EthERNet Attending various meetings, group discussions both face-to-face and via mail communication, training sessions, and workshops in AAUNet implementation Attending discussions in the process of selecting and implementing Zimbra open-source mail system. Attending meetings in the initiation of the integrated finance and budget information system (IBFIS) development project
Interview	Conducted face-to-face interviews with both technical and administrative (managerial) participants in the implementation of AAUNet, EthERNet, Zimbra open-source mail system and IBFIS
Archival data analysis	Design documents, project management structures, training procedures, letters of communication among varieties of actors such as project managers, funders, vendors and top level management.

The data collection was focused on the acquisition, accumulation, combination, transformation and distribution of capital which could help identify mechanisms for human capital and capacity building and sustainability of the cases considered.

5. CASE ANALYSIS

We apply capital flow analysis to four cases based on the stepwise framework for critical realist data analysis: the first focuses on a University-wide network development (AAUNet implementation) initiative followed by a case on the attempt to redesign and implement mail system in AAU, the third being a case on development of university finance software and the fourth is related to EthERNet implementation and operation.

5.1 AAUNet Implementation

Based on the framework indicated in section 3, the AAUNet project human capacity building process is discussed as follows:

Step 1: Description of events

The events are identified and compiled based on mainly through a documentation prepared by the principal author and partly by the informants.

Project Initiation

- **Summer 1996:** The former President of Addis Ababa University (AAU) assigned a Committee of five to study the computerization needs of the university.
- **January 1997: T**he Academic Vice President (AVP) set up a Network Study Team to develop a concrete proposal for the establishment of a university-wide computer network.
- **July 1997:** The Network Study Team proposed a wide area network connecting all faculties, departments, libraries and administrative units in all campuses
- **September 1998**: a two-man SIDA/SAREC mission reviewed the proposal by AAU and made further recommendation.
- **October 1998**: Dr. Ian Ellery, Director of IT and Computing, University of East Anglia, reviewed the AAU Network proposal (including the comments and recommendations of the SIDA/SAREC mission).
- **November 1998**. AAU compiled the final AAU Network design report by incorporating the views, comments and recommendations of both the SIDA/SAREC mission and Dr. Ian Ellery.

Project Funding

- **July 1997 – May 1998.** In due consideration of the level of investment required to realize the proposed network, AAU explored possibilities for securing assistance from international organizations and aid agencies.
- ETHIOPIAID and SIDA/SAREC indicated interest in supporting the project.
- **July 1998**. Agreement was reached that ETHIOPIAID will finance the core component of the project and the interconnection of the three campuses (6-kilo, 5-kilo and 4-kilo).
- And that SIDA/SAREC may consider funding the extension of the network to the remaining campuses of AAU.

Project Implementation

- The entire network is planned for implementation in two phases - The first phase project: networking three campuses: 6-kilo, 5-kilo, and 4-kilo and the second phase connecting remote campuses: Lideta, Tikur Anbessa and Debre Zeit to the central site.

- Ethiopian Telecommunications Corporation (ETC) agreed to assist in the procurement, installation, testing and commissioning of the fiber optic cables.
- December 1998-March 1999: The Technical Network Team prepared the Bid Document, for the supply, installation, testing and commissioning of network equipment, servers and within building cabling.
- December 1999. AAU officially released the bid document.
- July 2000. The Network Technical Committee submitted its report on the assessment of the bid for the supply of network equipments and installation of the network.
- **November 2000**. Supply contract drafted, negotiated and signed between AAU and Micro Sun Solutions. The agreement basically consists of two major items :
  - Procurements of required hardware and software (Goods);
  - Implementation (Services).

Procurement, Installation and Testing

- **December 2000 – July 2001 :** Procurement.
- **March 2001 – date** : Cable trunk installation, cable routing and termination
- **July 2001 – date : i**nstallation and testing of servers, network equipment and accessories for the whole network.
- **November 2001 to date :** Commissioning
- **July 2002:** Internet Connectivity has begun

Step 2: Identification of key components

The identification of the components or actors is made based on what are the objects associated to the events in the list, i.e. who have accomplished the tasks to create those events. Possession of capital, combination of the same and distribution are considered in identifying the components.

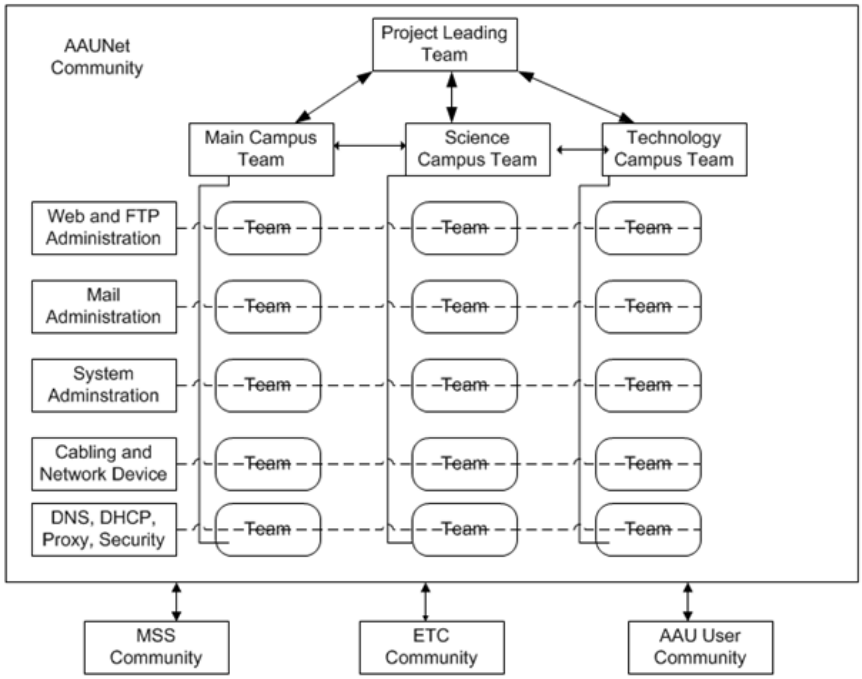

Figure 1. AAUNet Implementation Ecosystem

Step 3: Theoretical re-description

Cognizant of the fact that universities in developing economies play an active and dominant role in taking the initiative of designing and implementing networks to enhance the existing conventional means of communication, AAU launched a University-wide network (AAUNet) at the end of the nineties. The university top management organized a technical team to study the computerization of the academic and administrative functions to meet the needs of the increasing number of student population, to address problems of fragmented efforts in the integration of information technology based systems to the various units and to challenges of the 21st century. The study team investigated requirements and proposed a design for university-wide networking in collaboration with SIDA/SAREC and University of East Anglia Then efforts continued to secure fund. Even though the first attempt was to procure fund from SIDA/SAREC, it was EthiopiAid that was inclined to fund the first phase of AAUNet project. The fiber backbone connectivity was implemented by ETC, a government institution, based on agreement made with AAU. Bid was awarded to MSS for the supply, installation, testing and commissioning of network equipment, servers and internal cabling. Technical team composed of experts from IT related departments was established to work together with vendors, the management, funders and the user community.

Step 4: Retroduction: Identification of candidate mechanisms

Initially the network study team while investigating the computerization of the university acquired skills and knowledge [accumulation of Human Capital]. The expertise level of the study team was enhanced due to the interaction (knowledge sharing) with SIDA/SAREC mission and University of Anglia [accumulation of capacity Human Capital]. The initial attempt of the study team to come up with the proposal of the university-wide network and the interaction made with experts from abroad indicates the mechanism of self support open to comments by outsiders.

In the process of securing assistance (fund) from SIDA/SAREC and EthiopiAid there have been disagreements. Primarily SIDA/SAREC had shown interest to channel fund if the university would accept IT experts from Sweden to lead the project and configures the systems of the proposed university-wide network. However, the committee (the study team) from the university side did not accept the proposal of SIDA/SAREC and instead considered EthiopiAid to fund the first phase of the project. The project management team of AAUNet (earlier the study team) responded the following as to why this happened.

> "There were three fundamental reasons as to why the university preferred to be funded initially by EthiopiAid instead of SIDA/SAREC. Primarily, we, as Ethiopians, triggered by our long history, felt proud to lead the project, i.e., not to be dependent on others, though we are poor and still seek the fund from abroad; secondly the need to keep the image of the university as it is a prestigious one and that it has to play the leading role and remain exemplary for other institutions in the country; and finally the strong desire to build local capacity."

These were the initial mechanisms used in the university with regard to human capacity building for the project.

The design of the network [Organizational Capital] was one of the attraction mechanisms to organize the technical team. The charismatic and transformational leadership style of the anchorman [Symbolic Capital], who was initially member of the study team and later member of the project leading team, was among the important mechanisms to form the technical team (AAUNet implementation community). The anchorman's assignment as member of the top level management [Symbolic Capital] also attracted experts from the various IT related academic departments to participate in the University-wide project so as to form the AAUNet implementation community [Social Capital]. Through time various individuals and units are also attracted to join the community.

The participation among several individuals and units in the University in the process of the implementation of AAUNet through discussion, training, challenging each other helped in the acquisition of more knowledge, skills and experience [Human Capital]. As more people joined the AAUNet community including the realization of working together with the MSS and ETC community, the density of the structural ties was increased [Social Capital]. Consequently more expertise was available [Human Capital], which resulted in becoming more productive and thus more documentation (manuals, procedures, methods, tools, techniques) [Organizational Capital]. Self organized trainings conducted between MSS and AAUNet members and user training given to the AAU user community helped to gain more knowledge and skills [Human Capital]. Cross team construction, Observed quest for knowledge, ambition for success, tenacity, the ability to propose imaginative solutions to problems, the development of confidence, developing the culture of viewing the big picture – holistic thinking, developing shared vision – inculcating the sense we have done it together, have been the mechanisms that helped the success of the AAUNet project.

After the deployment of the successful network, the project leading team challenged the AAUNet community to work all over again on the installation, configuration and testing of AAUNet systems (mail, web, ftp, services such as DNS, DHCP, security, as well as the setup of network devices) to evaluate and ensure as to whether the local capacity building vision is realized as planned. The AAUNet community continued to support the established system ensuring that competence has been gained. Challenging the experts has been the mechanism employed to raise the level of technical expertise of the AAUNet community and to develop confidence.

The fund channeled from EthiopiaAid was invested by the University top level management to be coordinated and controlled by the project leading team [Economic Capital]. These were exchanged for the contributions given by the AAUNet project implementation team through remunerations as attractive mechanisms as well as to MSS and ETC as payments for the supply of items, installation and configurations of the same based on the contractual agreement. The initial investment [Economic Capital] was vital for the human capital and capacity building.

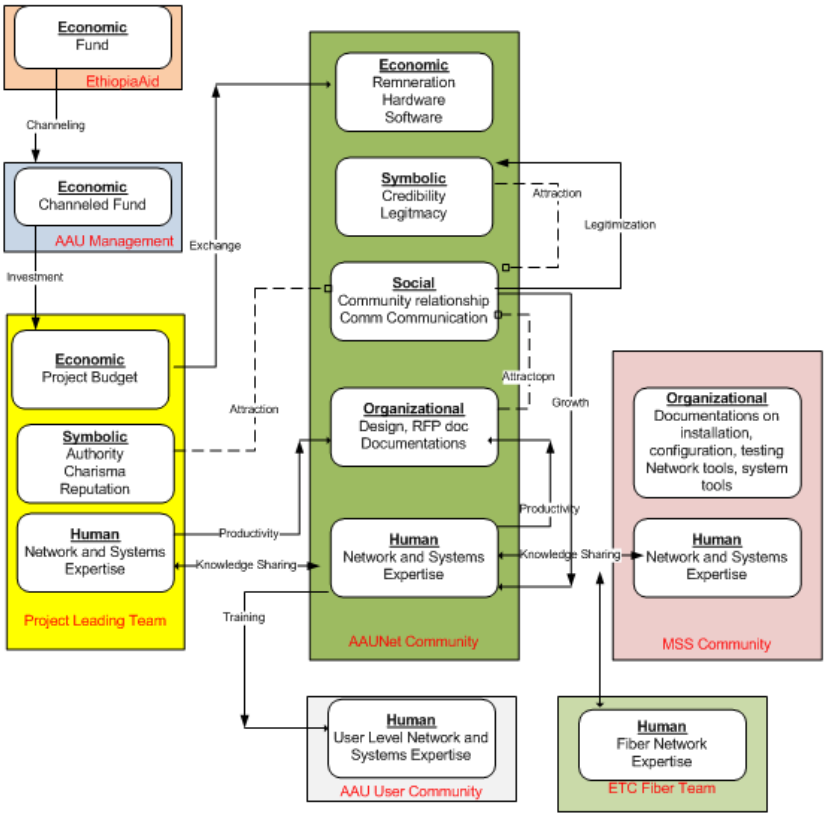

Figure 2. Capital Flow Diagram showing the growth of the Human Capital: AAUNet Implementation

Step 5: Analysis of selected mechanisms and outcomes

The project was recognized as one of the successful endeavors related to IS development in the University. Though the time taken to implement AAUNet was more than expected, there was a reasonable use of the financial capital. Given the tremendous services that emerged as outcomes of the completion of the project such as mail, web, ftp, Internet, etc, including the success of local human capacity building and the establishment of resilient social group for some time, the project acquired a reputation and was categorized as one of commendable projects that opened a new path for other similar institutions to follow the same footsteps.

Table 2. AAUNet Implementation by Capital Effects

Capital	Effect	Generated mechanisms	Contribution to the Human capital
Economic	+(Investment by top management), remuneration for key contributors and payment for the MSS and ETC	Attraction Exchange Productivity	Added energy on the participants from all community Growth in Human Capital
Social	+ (Early Community relationship), shared contacts, trust building + Interest and commitment among team members + trust, friendship, seeking success, knowledge building		Growth in knowledge, respect and thus productivity and resilience
Symbolic	+(From reputation, charisma, …) of the leading team adds credibility and legitimacy. Institutional entrepreneurship + (the produced documentations and services add credibility and legitimacy	Challenging the experts for more productivity and the acceptability from the experts side	Growth in showing interest and enthusiasm, take any challenge on the part of technical participants and thus increase in productivity and service
Organizational	+ (Development of network infrastructure and its associated documentations and services)	Attraction	Recognition, Legitimacy, usage of systems
Human	+ (Leading team knowledge, technical knowledge, vendor knowledge, knowledge acquisitions from the community or shared knowledge)	Quest for knowledge Ambition for success Tenacity imaginative solutions Confidence	Impressive local capacity building

From the preceding tables, it can be deduced that the capital flow, as dimensionalized by the typology of capital discussed, was influential and contributed to the success of the project. The conversion of one form of capital to another and the continuous loop observed in the production of the organizational capital by the human capital and then power of the organizational capital to attract social capital, which is responsible for the growth of human capital, has greatly contributed in the productivity of all community agents and thus successful outcomes.

The anchorperson's authority including the charismatic and transformational leadership style he employs [Symbolic Capital] combined with his information system development and implementation experience, skills, knowledge and educational background [Human Capital] enabled the AAUNet community to feel confident in the success of the project and thus it was attracted to participate. Furthermore the combined effect of symbolic and human capital has tremendously brought trust, team spirit among the participants. AAUNet community members became eager to develop skills and knowledge through the challenging tasks offered by the anchorman. Attracted by his social and symbolic capital, team members worked enthusiastically to produce tremendous organizational capital and functional outputs (services) to the user community.

Other combined capitals that produce synergy effects include the social capital and human capital of AAUNet community. The discussions and other communications made among the members of the AAUNet community and with others helped them share knowledge and skills to enhance their capacity to face all challenges. These two types of capital may also benefit from synergy in working together for the purpose of generating and accumulating additional capital beyond the mere sum of the capital deployed.

5.2 Upgrading the Mail System

Step 1: Description of events

The periods of the events are compiled from the informants.

During the period 2005 and 2011, several events have been registered on the attempts to sustain the mail system of AAUNet, though it ends up in vain. The mail system installed and configured during the successful implementation of AAUNet was iPlanet. During the period 2006 and end of 2011 an open mail system, Zimbra was employed until such time that if failed and currently the university migrated to the use of cloud computing, a free service of google mail. Even though, it is difficult to track the periods on which several events had occurred, we can describe the major events. These include: During 2004, most AAUNet technical and managerial experts left unit due to several reasons but mainly to navigate abroad for further education; recruitment of other experts was conducted. During the period 2006 -2007, a change of management and migration from iPlanet to Zimbra was conducted upon recruiting an expert from abroad both to consult and configure the Zimbra system. The 2008 – 2011 was a period of firefighting to fix problems of the mail system.

Step 2: Identification of key components

The participants in the above listed periods were: an expert who was operating iPlanet, the management of the ICT Development of the university, the newly recruited technical experts, the new consultant from abroad, the user community and individuals who volunteer to help in the process.

Step 3: Theoretical re-description (abduction)

The iPlanet system was successfully operating with the help of the single individual who was a member of the AAUNet project. The lack of attention from the management led this expert to frustrate. Support from this individual was in an intermittent fashion. The newly recruited personnel were unable to familiarize with iPlanet. The existing ICT officer has been replaced by new one. These were the causes for the recruitment of the technical consultant. The user community has been demanding the mail service badly. The ICT office had been requesting individuals from local companies to extend their support at times of difficulties.

Step 4: Retroduction: Identification of candidate mechanisms

There have been several attempts to fix problems on the iPlanet. However, the individual who was operating iPlanet overloaded with various tasks and had stopped working [reduction in Human Capital]. Recognizing his absence, other experts with less experience as well as inexperienced [lack of Human Capital] in managing mail systems were in charge of keeping the mail system up and running, but still in vain. Besides, there was little documentation, [lack of Organizational Capital]. Attention given to the new technical experts was also very low and hence the mail support process lacked credibility and legitimacy [lack of Symbolic Capital]. The newly assigned technical and business managers had no significant communication between them and the user units [lack of Social Capital]. As a result the user community was dissatisfied upon using the mail system; instead they rely on more on free mail systems [loss of Symbolic Capital].

The capital structure of the ecosystem changed in several ways. Productivity, reduced number of members, reduced number of relationships, and instability are observed. These are dysfunctional mechanisms that impede the progress of productivity in the mail support.

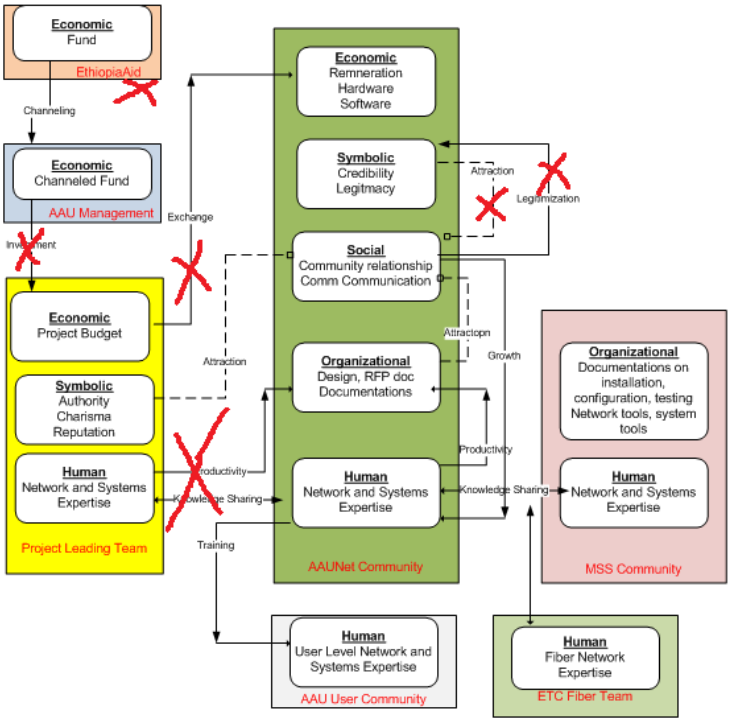

Figure 3. Capital Flow Diagram showing Loss of Human Capital: Mail System Development

Recognizing the fact that the iPlanet mail system had failed, a number of efforts were exerted. An expert from abroad was recruited to form a team to address the problem. Among other things, decisions were taken with regard to selection of the mail platform in which case a migration from the previous iPlanet which was proprietary system to Zimbra, an open source system. The decision was taken on the based on the interest and capability of the indicated expert, though there have been suggestions to look in to the problem thoroughly before deciding on Zimbra. This caused some of the team members to withdraw from the team [reduction of Human Capital] and [reduction in Social Capital]. Even if Zimbra software was installed and configured and it worked for some time, there were several complaints on the part of the user community which the technical team members could not handle it. This finally created frustration among the support experts and the user community [loss of Symbolic Capital]. The expert from abroad was not paid for the service he had been rendering for which he began to complain to the management. The management body could not settle the remuneration as the recruitment process was so informal that the finance department could not authorize the payment for the indicated expert [loss of benefit --- Economic Capital], which forced him to withdraw from the system. The problem persisted and no one could be able to fix the Zimbra system as a result the system failed to the extent that the user community lost trust in the local mail system.

Step 5: Analysis of selected mechanisms and outcomes

Loss of trust and frustrations are dysfunctional mechanisms caused by lack of the capitals indicated which directly have negative effect on the human capital and capacity building.

5.3 Finance System Development

Step 1: Description of events

The old finance system in place was not able to provide information to finance information users in general and in particular it failed to provide accurate information for funding organizations, a case in point is SIDA/SAREC, a Swedish based funding organization. The new Integrated Budget and Finance Information System (IBFIS) development project was conceptualized by SIDA/SAREC mainly caused by the need to know how AAU is managing the fund it provides to AAU. The budget officer then initiated this IBFIS project.

The following events on IBFIS initiation and implementation are shown below. The source of the data is from Final Report on IBFIS Completion, October 2010.

- August 23, 2008: Budget and Finance Automation Acquisition Committee (Steering Committee) established
- September 15, 2008: Consultant Appointed
- October 06, 2008: preparation of the RFP Completed
- October 13, 2008: Bid floated
- November 27, 2008: Bid Closed
- January 15, 2009: Technical Bid Evaluation Completed
- January 19, 2009: Financial Evaluation Started
- February 19, 2009: Bid awarded to HillMark Ethiopia PLC
- March 23, 2009: Kickoff Meeting held and the project officially launched
- Mar 23, 2009 - May-29-2009: Pre-customization Activities,
- May 12, 2009 – July 14, 2010: Finance system implementation module –by-module
- July 19, 2010 – Sep 27, 2010: Modularized Rollout Testing
- July 19, 2010 – Sep 27, 2010: System Integration
- October 2010: Closing

Step 2: Identification of key components

The stakeholders for IBFIS include: the steering committee, the consultant, Bid preparation and evaluation team, the project office, BPR unit, the technical team consisting of programmers, analysts and system architects, network support team consisting of members in ICT Development office of the university, network and software development consulting team, the vendor (HillMark Ethiopia PLC) and the finance information user community.

Step 3: Theoretical re-description (abduction)

The project was initiated by the budget officer. He took the charge of organizing and coordinating the project. His contact with SIDA/SAREC was strong. He initially formed an

informal team to conduct preliminary study on the budget and finance system of which he was a member. The team produced as-is and to-be system document. As a formal way of handling the project was indicated form the top level management a steering committee was formed. This committee consisting of 5 members who are managers in various units (ICT Office, Budget office, Finance office, Registrar office) was established with the responsibility of envisioning and overseeing the project. Primarily an individual (the consultant) prepared RFP (Bid document) for in-house IBFIS development followed by organizing a bid processing team consisting of members from finance unit, academic IT department, and the ICT office. The bid then was floated. Vendors applied. HillMark, Ethiopia, a local company was awarded after the bid was evaluated.

Step 4: Retroduction: Identification of candidate mechanisms

As the IBFIS project is one of the successful undertakings accepted by management body of the university and the finance information users at large, we have asked the informants as to why and how this happen. Almost all informants pointed the contribution of the RFP, that it is well designed and guided the project process. Based on such responses, we approached the consultant. We have figured out that the consultant who prepared the RFP had participated previously in the university-wide network project. The same person was recruited to support in the management and evaluation of the progress of the project. For the question posed to him on how the RFP contributed a lot to the projects outcomes:

> "My experience of participation in previous projects helped me to understand the context and identified the challenges and how we have overcome them as well as identified those practices that facilitated the project such as idea sharing, modularizing systems and tasks, creating friendship environment, trust each other and developing resilient behavior. Putting in place the right persons on the right position also helped us to be productive. In the RFP a well planned manpower organization was included that was followed during the project execution, especially communication among the stakeholders. The payment mode is different from earlier projects."

The experience that the consultant acquired earlier [Human Capital] caused the preparation of a concrete RFP [organizational capital] which contributed to the well organization of the teams to share knowledge and ideas [growth in Human Capital].

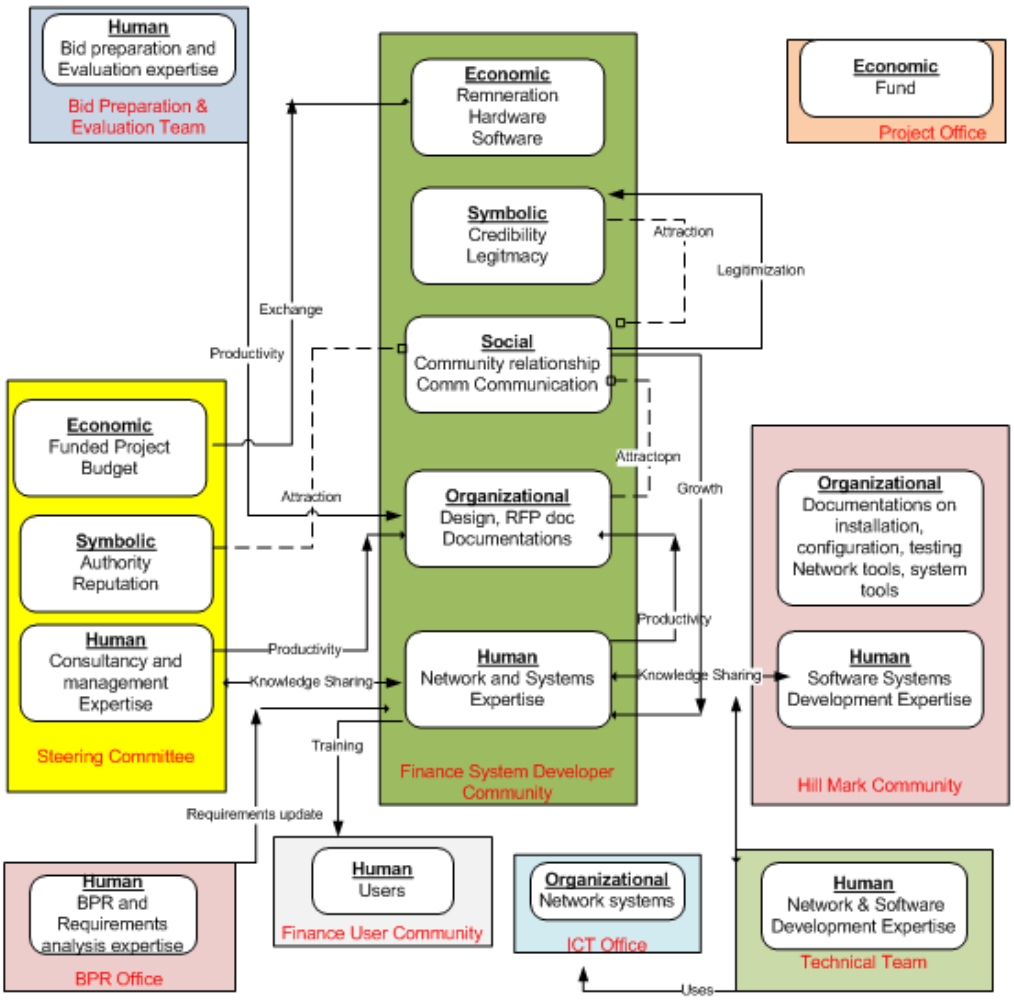

Figure 3. Capital Flow Diagram: Finance System Development

Step 5: Analysis of selected mechanisms and outcomes

The identified mechanisms include: learning from past failures and reconsideration of lessons learned, modularization -- division of tasks, changing mode of payment, redefining success criteria, experience building, documenting standards, creating relationship with vendors for further sharing of knowledge and ideas including creation of friendship to feel comfortable to call each other at times of troubleshooting of systems are required, attracting top level management and user community through improved provision of services, and creating platforms for favorable sharing of resources, trust building among stakeholders

5.4 EthERNet Implementation

Step 1: Description of events

The EthERNet project began at the beginning of the year 2003. Phased projects have been accomplished since then.

EthERNet was planned to be implemented in five phases, where four of them are almost completed and operational. These include: first phase: implementation of LAN/WAN for eight relatively old public universities; second phase: tele-education and (MPLS/VPN) for tele-education purposes; third phase: e-library system, for all public Universities, which include LAN and VPN infrastructure; fourth phase: tele-medicine and additional tele-education and the fifth phase which partly being implemented include the construction of WAN/LAN for 13 new universities.

Step 2: Identification of key components

Ministry of Education (MoE) being the owner, higher learning institutions in the country (Universities), Ethiopian Telecommunication Corporation, EthERNet office, currently Ministry of Communication and Information Technology.

Step 3: Theoretical re-description (abduction)

As part of the implementation/realization of the ICT Capacity Building Program (CBP) initiative, the Ethiopian Government has started to invest in ICT education as a discipline and as an enabler to delivering quality education and to an increasing student population. To this end, the Ministry of Capacity Building (MCB) has commissioned a number of projects, one of which is a Connectivity Master Plan Project. This project particularly relates to the design and development of a nation-wide backbone network that interconnects all institutions of higher learning and research establishments, namely, the Ethiopian Educational & Research Network, EthERNet. This project was initiated as a continuation of AAUNet which was taken as a model. MoE was given the privilege to own EthERNet. ETC was requested to give support in wide area connectivity. Successful vendors for supply and implementation of systems such as MSS and NCR continued to give support.

Step 4: Retroduction: Identification of candidate mechanisms

The success of the initial implementation of AAUNet [Symbolic Capital] caused the initiation of EthERNet project by the MCB together with the Ministry of Education (MoE). The assignment of designing EthERNet infrastructure and preparation bid document for the supply of network equipments and implementation was given to AAU experts [Human Capital] who accomplished successfully the AAUNet project. The experts formed a team. Two groups needed to be established in the team: a technical group to make survey of almost all higher-learning institutions in the country as well as to collect information from the Ethiopian Telecommunications Corporation (ETC) and a management group to address issues related to the administrative aspect of EthERNet. Documentations from the AAUNet [Organizational Capital] were employed to design and implement EthERNet. Expanding AAUNet to EthERNet contributed to the growth of Human capital and human capacity building. Expansion of systems is good mechanisms for human capacity building.

While Micro Sun Solution (MSS) won for the bid for the supply of network equipments, the implementation was accomplished by a local company that works with NCR (international

company). Both the supply and implementation undertakings were under the supervision of MoE.

The EthERNet implementation ecosystem is formed by these stakeholders: MCB the initiator and provision fund [Economic Capital]; MoE the owner for supervising the supply and implementation of networks and devices [Human Capital]; ETC for the support in fiber optics installation and telecom infrastructure [Human Capital]; AAU for consulting, designing EthERNet and processing bid matters [both Human Capital and Organizational Capital] based on the experience of successful implementation of AAUNet [Symbolic Capital] which attracted MCB; MSS for the supply of network equipments; NCR for installation and commissioning of EthERNet [Human Capital]. The formed EthERNet implementation ecosystem [Social Capital] as a whole helped the realization of interconnectivity among the various academic and research institutions. Coordinated approach and collaboration contributes to the building of human capcity.

Step 5: Analysis of selected mechanisms and outcomes

The mechanisms for the formation of the EthERNet ecosystem include: appreciation of successful network projects such as AAUNet, approaching experts who contributed to such success for more contributions by applying their experiences, collaborative efforts among varieties of stakeholders are few to mention.

5.5 Comparative Analysis

We now compare the structure of the ecosystem formation including the pattern of capital flows for all cases described with regard to capacity building.

The reduction of human capital in the case of the mail system implementation, configuration and deployment disrupted the progress and led to failure. The limited organizational capital, such as documentation, did not help the replaced experts. All together, limited coordination and the loss of legitimacy contributed to the failure of the mail system.

In the case of AAUNet implementation, IBFIS roject and EthERNet, one can observe the growth of human, organizational, social, and symbolic capital and their contribution to productivity of the experts and hence continued success and stability. From the foregoing, one can learn as presented as follows.

Table 4. Comparative analysis on capital flow

Type of Capital	AAUNet Project/ IBFIS/EthERNet	Mail system Project	Observational analysis
Symbolic	More possession, combination, conversion and distribution of such capital	No symbolic capital	The difference is visible
Social	More possession, combination, conversion and distribution of such capital	Less social capital	Less social capital affects the finance project
Human	More possession, combination, conversion and distribution of such capital	Less human capital	Less human capital affects the finance project
Organizational	More possession, combination, conversion and distribution of such capital	Less organizational capital	Less organizational capital affects the finance project
Economic	Sufficient possession	insufficient possession	Difference exists

6. LESSONS LEARNED

6.1 Capital Flows

The four cases illustrate that the type of capital supplied and created during the process of human capacity building on the one hand contribute to its continued success and stability in the all cases except the case of upgrading mail, where failure is reported. The lack of potential capital in the second case shows that the reduction in human capacity affects the outcomes. The conversion of the potential capital to other forms of capital is one of the observations made from the capital flow analysis, which shows that conversion to a necessary form of capital contribute to better human capacity building. The combination and distribution of capital in the form of sharing as well as the enactments on the part of the actors to contribute any form of capital and to benefit from others helps the attainment of power by the actors to contribute to the desirable outcomes. Where distribution of capital is less, the likelihood of attaining better outcomes is less.

The capital flow analysis shows how mechanisms devised by the participants (members) in IS projects are embedded in the capital structure as has been studied in this work. The capital flow influenced and impacted positively the participants to be more productive and thus the outcomes were of desirable and of paramount importance.

Table 5. Observed capital flows and their effects on human capacity building and outcome on IS projects

Cases (rows) Capital(columns)	***Possession***	***Combination***	***Conversion***	***Distribution***	***Mechanisms generated***	***Contributions on the project outcome***
Case1	*High*	*High*	*High*	*High*	*High*	*High*
Case2	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Case3	*High*	*High*	*High*	*High*	*High*	*High*
Case 4	*High*	*High*	*High*	*High*	*High*	*High*

6.2 Proposed Model for identifying mechanisms for human capacity building in IS projects

Using capital flow analysis, we have identified mechanisms that facilitate human capital and human capacity building. Furthermore, we have attempted to indicate how loss in capital causes dysfunctional mechanisms. As capital is possessed, combined, converted and distributed (transferred) among stakeholders, it is possible to identify the potential (capacity) of such capital to influence events to be generated. We have learned how capital enabled stakeholders in projects to enact and hence cause events. We have observed how the interaction among stakeholders produces the mechanisms listed in each of the cases analyzed. The mechanisms are generated through the capacity (capital) possessed, combined or transformed by stakeholders especially causing the human capital gained (human capacity building).

From the foregoing, based on ecosystem theory combined with the stepwise framework for critical realist data analysis and weaving capital flow analysis, we have shown the possibility of identifying mechanisms for human capacity building in IS projects in a developing economy. The model that can be used as an alternative way identifying is shown below.

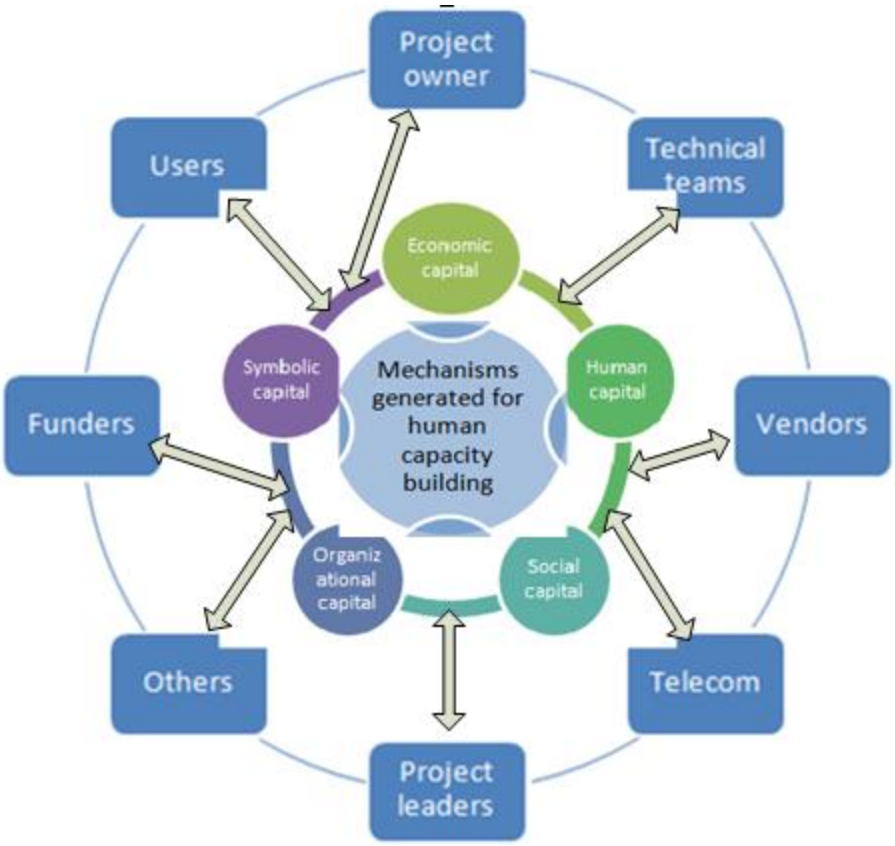

Figure 4. The Proposed Model to identify Mechanisms

7. CONCLUSIONS AND IMPLICATIONS

This work extends our knowledge of capital flow analysis based on ecosystem theory and the stepwise framework for critical realist data analysis as applied to understand and identify the mechanisms for human capacity building in IS projects in developing economies. This work identifies macro level actors in IS projects and macro level mechanisms. Considering micro level actors and micro level mechanisms can be of future work that we may address.

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