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Collaborative research: Assessing the value of interdisciplinary research in African countries

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Abstract
Interdisciplinary research plays an important role in addressing complex issues in African countries that are still grappling with grand challenges like water, sanitation, agriculture, health, desertification, renewable energy, environment, natural resources and security. The objective of this paper is to examine the importance of interdisciplinary research, how to establish right conditions for interdisciplinary working and to construct a model that applies project management principles for realization of research, innovations and interventions that are beneficial to development of African countries. Electronic databases were used to search for secondary data, findings summarized and analyzed thematically. The paper concludes that interdisciplinary research needs to be developed systematically based on stipulated agreements and policies which will be the basis of governance of the projects. It is recommended that principles of project management need to be applied in management of interdisciplinary collaborative research projects.

Keywords: collaborative, funding, interdisciplinary, multidisciplinary, project management, research

1. Introduction

Some of the global issues that are tackled through interdisciplinary research are environmental protection, energy security, natural disaster mitigation, preventing and curing diseases and ensuring food security. Organization for Economic Co-operation and Development (OECD) recognizes that cooperation between industrialized and developing countries is important because developing countries are often more affected by global threats [1]. Interdisciplinary approaches are necessary for dealing with critical challenges facing African countries. These approaches can be applied in training programs and research to form collaborative teams across disciplines. Interdisciplinary research is often decentralized with project members at different locations within the same country and also in external countries. There has been an acceleration of globalization and internationalization in the last 20 years which has resulted in economic integration with countries teaming up to address their needs and market products. Examples of this are, European Research Area (ERA) and Common Market for Eastern and Southern Africa (COMESA) which was established by eleven member states to co-operate in developing natural and human resources. This economic block aims at economic prosperity through regional integration which is a resourceful platform for regional research collaborations to handle common problems facing African countries [2].

Many countries have recently given higher priority to global issues and industrialized countries have turned to developing countries as crucial partners who can provide a wide range of expertise and natural research sites to future commercial markets for high-technology products [1]. Promotion of research and innovation helps to address societal challenges which require bringing together resources and knowledge from different fields, technologies and scientific disciplines. Getting the “hard sciences" and the "soft sciences" to work together as a way of coming up with good solutions to significant challenges which are rarely found within a single discipline, that is why Horizon 2020 supports and promotes interdisciplinary research [3]. National Science Foundation (NSF) recognizes that future generations will need to collaborate across boundaries, cultural boundaries and disciplines [4] which allows for combination of practical knowledge to advance understanding and making of constructive suggestions for solving local problems [5, 6].

Interdisciplinary research is defined variously, some of the definitions are: "research that involves a team of researchers from different disciplines that comes together around an important and challenging issue, the research question(s) for which is/are determined by a shared understanding in an interactive and iterative process” [7] while the National Academy of Sciences defines interdisciplinary research (IDR) as a pursuit that provides a format for conversations and connections that lead to new knowledge [8]. This kind of research is described as a cooperative effort by teams of investigators who have come together to deal with a challenging problem using different efforts and methods [9]. The Survey Report for the Global Research Council defines interdisciplinary research as research where two or more disciplines work or join together to produce a common body of research [10]. IDR is also defined as occurring where the contributions of the various disciplines are integrated to provide holistic or systematic outcomes within the social sciences or between the social, natural and life sciences [11]. These definitions show the different perceptions of IDR, with most of the definitions suggesting getting together to solve existing problems. For the purpose of this paper, we define the concept as research involving a team of researchers from

different disciplines coming together to work around an important or challenging issue. In the past, researchers have worked individually or with colleagues in their own discipline mainly because of the rewarding system of faculty by universities, however, there is increasing demand for interdisciplinary research in health, environment, climate change, infrastructure and agriculture [5, 1, 7, 12].

2. Rationale for Interdisciplinary Research

Global literature argues that IDR plays a key role in addressing grand challenges faced by society and funders are viewed as playing a catalytic role in encouraging interdisciplinary research by identifying and communicating these challenges for sensitization and action [9, 4, 5, 7, 10]. There is a growing need by funding agencies, universities and research institutions to tackle social problems that cannot be adequately addressed by single disciplines [13]. It is argued that interdisciplinary approaches are necessary for attacking critical challenges facing the world today such as climate change, sustainability, energy and public health. This underscores creation of European intergovernmental research organization which was established because scientific or technological fields require large investments and complex structures which are too costly and complex for single countries to manage [14, 6]. The European intergovernmental organization was set up with co-funding member countries for developing scientific and technological research in fields of strategic importance [14]. In Africa, there are problems that are best handled through collaborative research such as poverty, chronic and terminal diseases and public health concerns [7, 1].

Further evidence of the significance of interdisciplinary research is the number of studies that have been carried out to assess the correlation between interdisciplinary research and productivity, impact and cooperation; case studies on interdisciplinarity in Africa, Americas, Asia-Pacific, Europe and Mean [3, 10]. Resultant co-publications (76%) are indicative of intra and extra-EU collaborations which are knowledge and resource driven [14, 1]. There is a consensus on the need to advance interdisciplinary educational programs and research opportunities in universities where the academic structure is seen as a barrier to interdisciplinary research. To handle this complexity, there is creation of interdisciplinary programs, research groups, centres and institutes as integral parts of higher education institutions to deal with global issues that require multiple disciplines [5]. The need to prepare students for a global market calls for interdisciplinary training of students, notably the lines between "traditional" fields are increasingly getting blurred due to federal funding which offers support to cross-cutting research like biomedical research, science education and training [5, 8, 15]. Many of these initiatives are interdisciplinary in nature and culminate into building capacity to support research through building research foundations that drive discovery, laboratory work, provision of community health services, research ethics and ultimately lead to breakthroughs, new treatments and enhanced lives. This shows the place of IDR in opening up new areas, providing flexibility and expansion possibilities for traditional disciplines [1, 5].

Additionally scholars argue for creation of a new generation of students who combine a disciplinary depth in order to reach out to other disciplines and work in interdisciplinary teams, this is because understanding social challenges require collaboration of scientists, social scientists technologists and engineers [9, 7, 1, 5, 6]. Collaborative research involves various disciplines working together to seek answers to agreed and developed questions focusing on a common goal and it is gaining currency as a prominent approach [7]. It involves engagement of researchers in communication, discussion, sharing resources, collaborative research activities and dissemination of findings. The concept uses a problem-focused approach, in health sciences it deals with eminent health issues, in Agriculture it deals with food security and technology while in environmental sciences it deals with pollution and climatic changes.

Evidently, there is increasing support from governments and business for interdisciplinary programs focusing on long-term problems in the economy, society and government. Interdisciplinary research is viewed as central to solving problems through knowledge development, creativity and innovation. In Kenya, National Research fund finances multidisciplinary collaborative research which is viewed as a strategic response to the national socio-economic development agenda as described by vision 2030 [5]. The intention is to promote multidisciplinary research to catalyze socio-economic growth and there is increasing evidence of improved outcomes from collaborative research in health [7].

3. Methodology

Full text research articles and books on interdisciplinary research and project management were reviewed. Electronic databases used to search for secondary data were EBSCOhost, Directory of Open Access Resources (Open Doar), JSTOR and Google Schloar. Resultant data was then synthesized with reviewed literature from relevant articles and books. Findings were summarized, integrated with the existing literature and analyzed thematically.

4. Importance of Collaborative Research in Solving Grand Challenges

There are several grants targeting grand challenges like Bill and Melinda Gates Foundation that supports early - stage research projects and innovative ideas that could lead to new vaccines, diagnostics, drugs and other technologies targeting diseases that claim millions of lives [16]. Royal Society-DFID: Africa Capacity Building Initiative funds scientists who want to develop collaborative research consortia between sub-saharan Africa and a university or independent research institute to strengthen the research capacity of universities and research institutions in sub-saharan Africa. These development innovation ventures will support innovative solutions that could lead to development outcomes across multiple developing countries and multiple sectors within

these countries [17, 10]. These funding opportunities show the increased interest of high resource countries to tackle grand challenges through opportunities that draw various disciplines and target various needs like population, health, health systems, alcoholism, dietary intake and physical activity [17].

Significance of interdisciplinary research in solving grand challenges is evidenced by the development of formal policies for management of intersciplinary research. National Science Foundation (NSF) in USA has specific policy for IDR while European Research Council (ERC) and Australian Research Council (ARC) are in the process of formalizing relevant policies [10]. In Africa, South Africa National Research Fund promotes and supports research through funding, human resource development and provision of research facilities to facilitate creation of knowledge, innovation and development in all fields [18]. Mozambique established National Research Fund for building research capacity to promote science, innovation and technology while Kenya made a strategic response to the national socio-economic development agenda through promotion of multidisciplinary collaborative research to catalyze socio-economic growth. These initiatives are aimed at driving collaborative research which fills the gap created by inadequate funds and catalyzes initiatives that will help in dealing with grand challenges [19].

5. Establishing Right Conditions for Interdisciplinary Working

The future of low resource countries depend on interdisciplinary research to solve the challenges faced. Positive outcomes of these collaborations require conducive working conditions. To establish right conditions for working in interdisciplinary research special considerations need to be made for designing IDR programs that can survive risk and complexities of interdisciplinarity. One of the strategies would be developing of institutional policies and regulations to guide the collaborations which can be documented in a Memorandum of Understanding. This would help in development of steps, mechanisms and acceptable practices necessary for overcoming barriers and resolving conflicts. Timescales are an important consideration because it would determine successful implementation and productivity. Quite often start up phases take at least two years with actual implementation taking place in the third year, this is why the training grant for International Research Ethics Education and Curriculum Development Award in 2013 to 2016 had the option for a two year planning grant [10, 15]. Building a strong IDR team is key for productivity, one of the role of funders is capacity building through training or provision of infrastructure. Kenya AIDS Vaccine Initiative-Institute of Clinical Research (KAVI-ICR) is a joint initiative that offers training in epidemiology, research design, immunology, good clinical practice, data management and cohort establishment and there is emphasis on technology transfer. Researchers in this clinical trial have also been trained in use of equipment, laboratory work, biostatistics and researchers are sponsored to attend relevant scientific conferences [20, 21, 22]. Planning and implementation of collaborative programs require that members meet to exchange ideas, establish common methodology, build trust and understanding. This is achieved through design of physical and social spaces to sustain interdisciplinary networks and enhance collaborative research [10].

To support collaborative research, it is necessary to develop policies that stimulate coordination and cooperation of participating countries in development and implementation of joint calls. Successful collaborative efforts require a project leader who has ability to solve problems, ability to cope in multiple cultures, communicate, have prior experience in projects and familiarity and knowledge of the business. On the other hand, research teams must have competent researchers, world-class research infrastructures, competent research institutions, effective knowledge sharing and good coordination [14, 23]. The diagram below illustrates development of partnerships for collaborative research:

The proposed model forms the basis for development of partnerships for equitable collaborative research. The success of all collaborations depends on establishment and agreement on an organizational structure for efficient and effective management of activities and operations. The hierarchy of command can also be used for conflict resolution. Management should include the principal collaborating institutions, lead persons from each institution with defined roles, leads for each research question or aims of the collaboration and a secretariat to support day to day activities. Aim or research question leads should be from host institutions for appropriate implementation and sharing of benefits. The collaborating partners can participate through sharing of knowledge, provision of laboratory facilities, data analysis and capacity building, these will be determined by the type of collaboration and the roles of each partner [20]. To develop and implement plausible partnerships, it is proposed that collaborating institutions need to develop agreements to drive formation of partnerships that are equity based [14]. This would prevent exploitation of partners and result in joint ventures that help in solving grand challenges. The next step would be signing of contracts, this process is significant in that it would then form the basis for developing an organizational structure to guide the research partnership, formation of the project team and implementation within stipulated institutional policies.

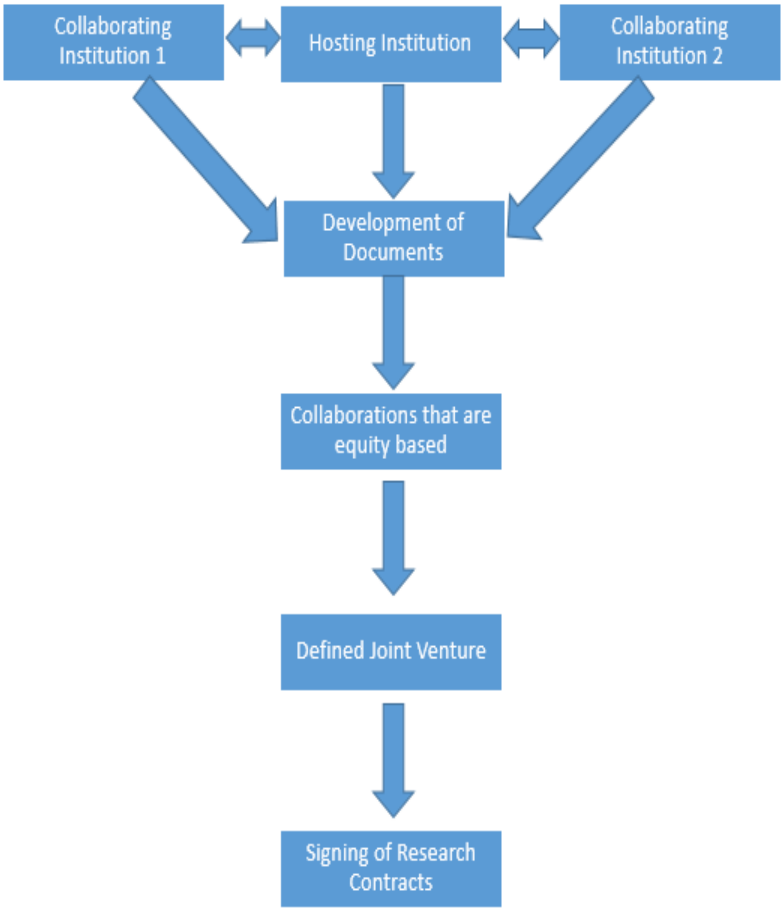

Fig 1: Development of Partnerships for Collaborative Research

6. Project Management Principles for Realization of Research, Innovation and Intervention

Indeed interdisciplinary research can be anchored on the principles of project management and therefore the need to treat IDR as unique endeavors. Management and measurement of performance of these projects should look beyond traditional management and standard measures because of their uniqueness. Success of these projects would benefit from employing project specific metrics, key performance indicators and qualitative assessment to monitor and evaluate performance against specific goals [10].

Interdisciplinary research is distinct in terms of its endeavor, composition of the team and the duration of the project which requires that management strategies are equally specific. IDR is variably motivated, sometimes by an existing problem or the nature of the subject, for example traffic jams in urban centres would be handled by specialists in transport, that is engineers and they would require economists and sociologists to deal with the interdisciplinary aspects [11]. The nature of the subject in itself would require a relevant team to handle respective issues. Selection of project team members needs to be cautious in terms of interest to deal with 'real world' problems, tackling socially relevant issues and perhaps contributing to advancement of academic disciplines [11, 24]. Implementation of interdisciplinary projects requires strategies for integration of disciplines. A framework to drive this process would assist in dealing with barriers and challenges. It is safe for IDR projects to undergo a preliminary research phase to provide baseline information to be used in determining need and the best way of handling an issue. In project management, this is referred to as a feasibility study which forms a good basis for developing a proposal whose outcome represents a justifiable decision on the projects mandate and boundaries [25, 11].

Success of interdisciplinary teams depends on sensitivity to the differences in communication styles, time differences and diversity of culture within the group and within disciplines. It is therefore advocated that culturally competent practices are developed to facilitate IDR. To do this, each participant needs to have value diversity, develop self-assessment and strive to understand one's own disciplinary culture and be sensitive to the dynamics of culture interaction [13, 24, 25]. To promote the formation of a functional cohesive team involving researchers in several disciplines, several considerations have to be made like the location of researchers which is rarely central thereby requiring development of communication plans and strategies. Diversity of researchers demands leadership that is sensitive and responsive to multi-diversity. This means that language and communication issues are key. Respective institutional structures and procedures for collaborations have to be factored in during establishment to guard against inhibitions during the life of the project. An effective interdisciplinary team requires extra effort and the demands on the project lead are immense [11, 24].

Team work is key in IDR which demands that individual researchers need to have attributes and attitudes that enhance group work and help in coping with group dynamics. These skills include: flexibility, adaptability, creativity, curiosity and willingness to learn from other disciplines, an open mind to ideas from other disciplines and experiences, good communication and listening skills and a good team worker. Researchers who have knowledge and skills in more than one discipline are beneficial to the team as they will help in understanding across the project's main domain and they will be easily open to new ideas. It is important for all researchers to have a clear vision of the project and the expected outome [[11]]. Furthermore, internationalization of research has various advantages such as mobility of researchers, collaboration between partners from different countries and knowledge exchange [14].

Developing countries can adapt the framework used by the Programme on Innovation, Higher Education and Research for Development which proposes Centres of excellence (CoE) as a tool for capacity building to build critical mass in identified areas of need, enhance cooperations, lead to professionalization of the researcher and transfer of R&D capacity across sectors. CoEs can be a platform for research, innovation and learning. Through them funds can be sourced for interdisciplinary research, generation of scientific excellence, stimulation of technological innovation, development of policy and interdisciplinary learning. To achieve this aim, a strategic plan can be developed to aim at basic and strategic research, innovation and technological advancement and social and economic development with a view to attack challenging problems in society learning [26]. In addition to this, this paper proposes a model which is based on the project cycle to guide activities in interdisciplinary projects. The initial phase begins with conceptualization of the idea. All researchers need to be involved in developing research questions, for example in vaccine development or HIV cure to help in understanding different perspectives and building common ground for continuation of the project. This is the point at which a feasibility study can be carried out to inform the design process and for making justifiable decisions which lead to the design and planning phase [24, 25]. This phase would be more resourceful if it involves researchers, stakeholders including funders and relevant government arms; community participation helps in identification and prioritization of societal needs. Community engagement is achievable through the development of community advisory boards to represent the community and for community entry [27]. It is at the planning stage that budgeting for equipment, activities, remuneration, capacity building and monitoring and evaluation can be done to allow a smooth implementation process that factors in all requirements and activities [23, 24].

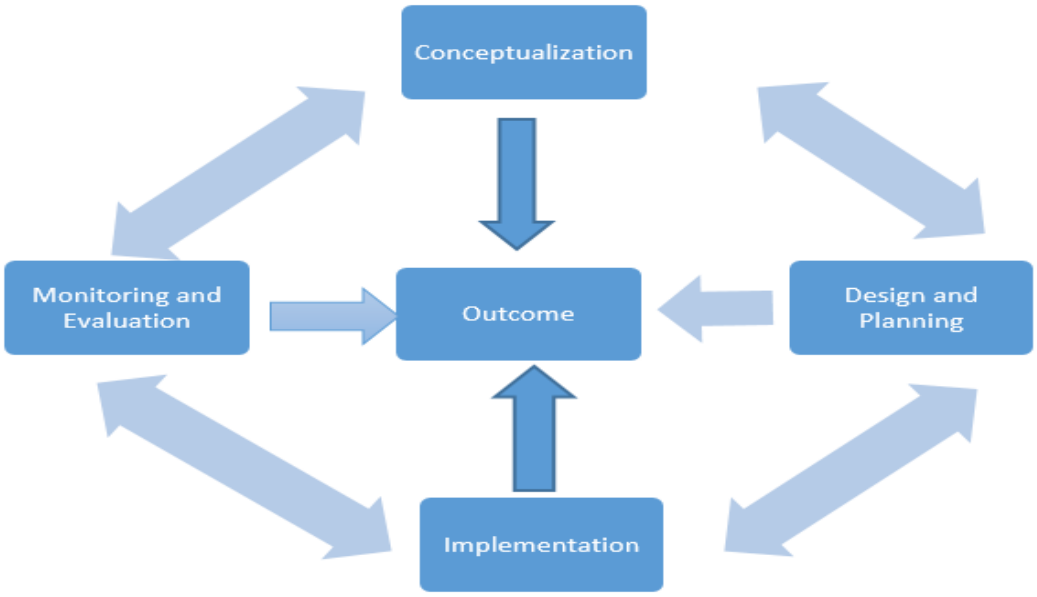

Fig 2: Interdisciplinary Project Management Model Based on the project cycle to guide project activities

The implementation phase would begin with appointment of project leaders who will then form the project team based on required qualifications, flexibility, adaptable skills, good communicators and listeners. This kind of team will be instrumental in establishing right working conditions with particular focus on cultural diversity, communication and language, participating disciplines for development of common terms and time difference [23]. The fourth phase is Monitoring and Evaluation (M&E) which requires planning for a monitoring and evaluation system complete with a department and necessary expertise. The monitoring and evaluation team needs to develop an M&E plan to guide the process and ensure achievement of desired outcomes. Collaborative M&E will contribute immensely towards prevention and mitigation of risks which will culminate in achievement of project goals. All the above processes will culminate in the envisaged outcome which could be development of a drug, a medical instrument, a vaccine, a cure, an innovation or intervention for example phylogenetic studies can lead to the development of behavior change

programs that target at risk populations, adolescents and individuals [23, 24].

7. Recommendations

1. Global literature review reveals assessment, evaluation and measurement of interdisciplinary research proposals and outcomes as one of the challenges of IDR is assessment, evaluation and measurement of interdisciplinary. The peer review process requires modification of the review process to include establishment of specialist panels drawn from multidisciplinary experience and a two-tier review process with the second level involving reviewers who understand how to evaluate interdisciplinary projects. This means that there is need to build an extensive pool of evaluators to increase international collaborations and develop a procedure to guide reviewing interdisciplinary research.
2. Lessons learnt from advanced or completed projects can be used to initiate new collaborative ventures and improve existing ones so that funds, time spent and effort culminate in advancement of knowledge, innovations and interventions to spur socio-economic development.
3. Since a lot of finances go into funding of interdisciplinary research and it is seemingly a practical avenue of solving world problems, funding organizations, governments and stakeholders need to concert efforts to analyze the relationship between international collaboration and impact of respective research collaborations.
4. Interdisciplinary research involves researchers from different disciplines, different institutions and many times different countries which can result in complexities. To manage ambiguities and conflicts, there is need to develop international, national policies and institutional policies to govern collaborations.

8. Conclusion

Many governments in Africa are still grappling with basic problems like food, shelter and security. To deal with these problems concerted efforts by government, researchers, industry and funding agencies need more proactive and pragmatic efforts that involve different disciplines for synergy. Interdisciplinary collaborative research is the avenue through which grand challenges in Africa can be solved because these initiatives provide a platform for sourcing funds, provision of expertise, research capacity development and development of knowledge which are necessary facets for research and development.

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