

Five Stage Model for Assessment of Research Utilization

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Abstract— This article focuses on assessment of academic research utilization produced by highly qualified academicians working in the universities offering degrees in field of Environmental Sciences and Environmental Engineering. The article presents five stage model for assessment of academic research utilization for development based on various criteria including purpose of research, funding bodies of research, relevancy of research with environmental issues, development mode of research, end users of research, mediator source for research utilization and intellectual property rights for research. This research is based on case study approach. Findings show that research have been disseminated in the form of research papers at larger number but very few of academic research have been utilized for development. Academic research has been utilized by different national & international organizations. The research is utilized in form of PhD thesis reports and other project reports funded by HEC, Universities and other national and international organizations. The outcomes of research utilization are either in form of new developed processes, services or policy guidelines under protection of copyrights. The findings also revealed co-operation of academicians with other stakeholders. However, none of the research has been utilized in the development of new Product or new technology under protection of industrial designs or patents. Though effective research work has been done related to solve different environment issues such as; Alternative Energy production, Air Pollution, Road Transportation, Coastal Management, Energy Crises, Global Warming, Renewable Energy Production, Biodiversity, Waste Management, Water Purification.

Index Terms— Academicians, Academic Research, Development, Utilization

1 INTRODUCTION

THE knowledge becomes an increasingly important part of innovation, universities as a knowledge producing and disseminating institutions play a larger role in the development. There is empirical evidence that identifying, creating and commercializing intellectual property have become institutional objectives in various academic systems [1]. Research in itself is a response to man's unending quest for knowledge. On similar grounds, the analysis of the research output of a country determines its progress in various fields [2]. Denny [3] reported that developing countries consider there is rather a need for studies on immediate everyday problems than curiosity - driven research; it is more appropriate for industrialized and rich than poor countries. Edward et al., [4] argue that production of knowledge depends on knowledge infrastructures which comprised as "Robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds". It can be said that lack of basic research leads to a poor knowledge and expertise capacity of the nation.

It is assumed that the concept of targeted research has emerged more recently: unifying basic research and applied research, it arises from social needs and is commissioned to resolve a concrete issues, it is called mode-2 science [5], [6] or post-normal science. The aspect of research does not necessarily refer solely to the human and social sciences; research on emissions of atmospheric pollutants by road transport has in the past 20 years highlighted essential parameters such as vehicle operating conditions (speed, gradient, ambient temperature, etc.) and the composition of vehicle fleets. In the field of rail safety, research has shown the importance of maintenance procedures and their optimization, evaluated in terms of overall transport-system efficiency and not only of short-term profitability. In the environment field, work on the hierarchy of the physical and chemical causes of declining ecological quality of

watercourses will allow better organization of the measures needed for watercourse restoration and the health of local populations [5].

Research paper answer the research question: "How to assess the utilization of academic research for development?". To answer this question; five stage model for assessment of academic research utilization for development is developed. Model based on the review of literature and refined with the interview findings conducted with the selected cases, by making practical implications of developed five stage model for the assessment of academic research utilization for development in the field of environment. Focusing on the role of academic institutions, this research assesses the utilization of academic research done by highly qualified faculty members with PhD qualification working in universities offering degrees in the field of environment in Sindh, Pakistan for development. Research paper comprised of different sections of discussion, starting with introduction of research following the review of previous work done related to research area and development of five stage model, methods and techniques used in this research to achieve the desired results, analysis of data and obtained results with final conclusion and recommendations are discussed in detail. Following section comprised of detailed literature review related to assessment of research utilization.

2 REVIEW OF LITERATURE

Utilization of research for the practical purpose is not a new concept. Defining from the literature Mastrilli, [7] says that there is considerable confusion surrounds the definition and use of terms that describe the process of putting research knowledge into action. When researchers have attempted to create a search filter, they identified more than 90 terms that signified the use of research knowledge in health care. Com-

monly used terms included implementation science, research utilization, dissemination and diffusion of knowledge, research use, knowledge transfer and exchange, and knowledge translation. McKibbin [8] also noted differences in how terms were used among publications from the United States, Canada, the United Kingdom, and Europe. In the Canadian literature, the terms knowledge transfer and exchange (KTE) and knowledge translation (KT) have been commonly used to signify the process of incorporating scientific findings into health care practice.

Knowledge transfer is defined as a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the health care system. Descriptive studies in this field have indicated that the KT phenomenon may involve many complex interrelated factors and processes. Several theoretical frameworks have emerged in the literature to enhance our understanding of this complex phenomenon. In most of these models, the use of research knowledge in practice occurs in the implementation phase of the KT process [9].

Knowledge utilization pertains to the dissemination and use of research results by researchers in subsequent investigations, and by practitioners in applications. Ilves [10] examined one aspect of knowledge utilization by studying the interaction of MIS researchers with prior research efforts based on references attached to MIS journal articles. By making addition in the literature this study examines other aspect of knowledge utilization by practitioners exploring different developmental approaches and its intellectual property rights. Knowledge transfer can be defined as the means by which expertise, knowledge, skills and capabilities are transferred from the knowledge-base (for example, universities, research centers or research organization) to those in need of that knowledge; for example, industries, social enterprises or nonprofit organization [11]. Knowledge transfer strategy with five questions provide an organizing framework for knowledge transfer starting with question: What should be transferred to decision makers (the message)? To whom should research knowledge be transferred (the target audience)? By whom should research knowledge be transferred (the messenger)? How should research knowledge be transferred (the knowledge transfer process and supporting communications infrastructure)? With what effect should research knowledge be transferred (evaluation)? [12].

Knowledge utilization focused on five key questions; what is the message? Such messages could include credible facts, data, findings, conclusions, and body of evidence that can be expressed in actionable idea. Who is the audience? What can be

transferred? Messages should be developed with particular audiences in mind that is likely in a position to use the research based information for decision making purposes. Who is the messenger? Attention to messages is enhanced if the audiences regard the messenger as a credible spokesperson. What is the transfer method? Transfer methods need to be carefully considered in light of a number of factors, including the nature and size of the audience and available resources devote to dissemination. What is the expected outcome? The dissemination plane should consider what impact the developed activities will achieve before it is implemented [13]. By making addition in literature, article makes empirical study to answer these questions by making exploration of current practices of knowledge utilization status in field of environment at Sindh, Pakistan. Article answers the above discussed questions by developing five stage model for assessment of academic research utilization.

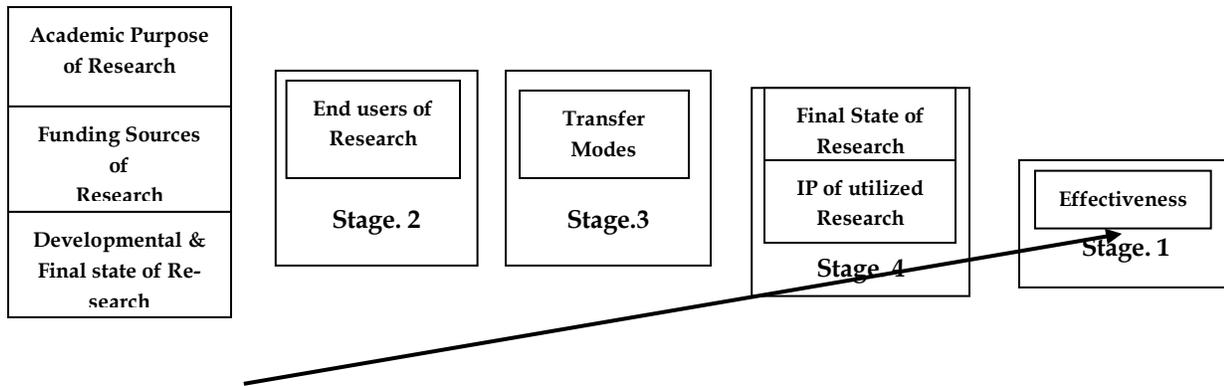
3 DEVELOPMENT OF FIVE STAGE MODEL FOR ASSESSMENT OF ACADEMIC RESEARCH UTILIZATION

This research assesses the utilization of academic research of selected cases of PhD faculty members in the universities in Sindh offering degrees in environmental engineering and environmental sciences. By exploring additional knowledge in the questions to assess the academic research utilization from the producer perspective universities are selected as a research producer. Five stage model for assessment of research utilization shown in figure 1. Developed model is developed based on the questions identified from the literature. Stages of developed model are discussed below in detail.

3.1 Stage 1. Assessment of Academic Research Types

Literature suggests that it is important to answer the question "What was the type of transferred research knowledge to end users?" Because; Empirical research on the types of research that influence decision making justifies this approach. Research on managerial and policy making is mostly utilized in form of ideas not data which influences the decisions making [12]. State of research produced in the academic environment is influenced by academic purposes, funding bodies. In academic environment such messages could include Self PhD Thesis, PhD thesis of student, Self Masters' Thesis, Thesis of students and Research project reports. Literature revealed that high level of importance is accorded by academic researchers to the use of refereed publications as a method through which to disseminate their research [14]. This research also explores about funding agency of utilized research to assess either utilized research is funded by the Parent University, industries, national educational organization as higher education organization, self funded research by researcher and other national and international resources of research funding. Lavis et al [12], articulate that research organizations should transfer actionable messages from a body of research knowledge, not simply a single research report or the results of a single study message includes the developmental states of utilized research as idea, experimenting and prototype.

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3.2 Stage 2. Assessment of End Users of Academic Research

It is evaluated that the key question in the promoting better utilization of research knowledge is to sort out whether knowledge translation process differ according to types of users, and if so what are the nature of processes at hand [15]. It is developed to answer for the assessment of academic research utilization as; "Who were the end users of research?". The research literature makes clear that a message's target audiences must be clearly identified and the specifics of a knowledge transfer strategy must be fine tuned to the types of decisions they face and the types of decision making environments in which they work. Research produced in the universities can be utilized by different national and international organizations working in different areas of environment such as water, air, land, transport, policy etc. Article explores problems solved by the academic research and its end user organizations.

3.3 Stage 3. Assessment of Sources of Academic Research Transfer

Research knowledge is transferred through different sources to end users there are different mechanisms through which research knowledge is transferred to end users. Cherney et al., [13] argues that greater collaboration between academic research producers and users is seem as one way of addressing the dissonance between knowledge production and its transfer or translation to policy and practitioner contexts. It makes important to assess "Who were the messengers?". Different research transfer mechanisms were identified such as through personal links, through technology transfer offices, through national programs initiated by national and international organizations such as higher education funding bodies, councils, through media, through workshops, seminars, conferences and trainings.

3.4 Stage 4. Assessment of States of Academic Research Transfer

Research knowledge may be used in instrumental, conceptual, or symbolic ways [12]. It is important to answer that "How academic researches were utilized by end users?". Transfer method needs to be carefully considered in light of a number of factors, including the nature and size of the audience and available resources to devote for dissemination. Finally research is developed as a product, process, services, new technologies and policy guidelines. For utilization purpose academic research is protected in form of different intellectual property rights such as copyright, patent and industrial design.

3.5. Stage 5. Assessment of Effectiveness of Academic Research

Last stage of developed model assess the effectiveness of researches. At this stage model answers the question "What were the outcomes of utilized academic research?". Outcome of research can be assessed by identifying the desired impact of utilized academic research. It includes set specific objectives for each type of end user. To evaluate the impact of knowledge transfer strategies, the academic research utilization activity should be focused on what impact the developed activities will achieve before it is implemented [13]. This article offers additional contribution in literature, providing empirical evidences to answer these questions in practice to explore the current practices of academic research utilization produced by the PhD faculty members in the universities in Sindh by the multiple national and international organizations working in the field of environment.

4 RESEARCH METHODOLOGY

Academic research produced by PhD faculty members working in the universities has been assessed as in changing world higher education institutions are responsible to provide favorable responses to social needs and it has proven by experiences that universities can provide best performance to the community [1], [16]. This research focuses on the assessment of academic research utilization; produced by PhD faculty mem-

bers working in universities in Sindh offering degrees in field of environment engineering and environmental sciences using case study approach. A case study is a research method involving an up-close, in-depth, and detailed examination of a subject of study (the case), as well as its related contextual conditions [17]. Cases have been selected based on the offered degree program in the universities by selecting such which is focused to solve the environmental issues to achieve the target of environmental sustainability in Sindh Pakistan. Initially information about universities and their faculty were collected from the official websites of universities. From total 8 numbers of identified universities offering degrees in field of environment, 3 universities offer degrees in environmental sciences and 5 offer degrees in environmental engineering. In terms of highly qualified faculty there are 24 PhD faculty members 12 working in the universities offering degrees in environmental engineering and 12 in environmental sciences.

Required data have been collected through detailed interviews with the PhD faculty members working in the universities in Sindh offering degrees in field of environmental engineering and environmental sciences. Identified faculty members were contacted by telephone and emails. Semi-structured research instrument has been developed to collect the required data in this research.

Research questions asked in Semi-structured interviews are often preceded by observation, informal and unstructured interviewing in order to allow the researchers to develop a keen understanding of the topic of interest necessary for developing relevant and meaningful semi-structured questions [18]. Initially research instruments were designed based on thorough review of literature and refined with comments of respondents. Research instrument used in this research were comprised of both open and closed ended questions identified from the literature and were finalized during interview session. From total 24 PhD faculty members, 22 face to face interviews about 1 hour with individual respondents on the availability of respondents. Interviews held during July 2014 to December 2014. Obtained data has been analyzed using statistical packages for social sciences SPSS Version 20. Descriptive statistics, pie and bar charts have been build to organize the obtained results to answer the research question. Following section will present the data analysis and findings of results

5 DATA ANALYSIS AND RESULTS

Utilization of academic research done by selected cases has been examined based on the five stage model shown in figure 1. At the start research identifies; Academic purpose of research, funding bodies of academic research, state of academic research, end users of academic research, transfer modes of academic research, final state of academic research, intellectual property of utilized academic research at the environmental issues focused by the utilized academic research have been explored. Results related to all stages included in the developed five stage model for assessment of research utilization are discussed in detail in the following sections.

5.1 Stage 1. What were transferred to end users from

academic research?

Research produced by the academicians is done to fulfill academic requirements and it is finalized by different organizations in form of thesis reports, project reports and research papers in journals and conference proceedings. Research done in academic institutes which will be financed by different funding bodies, Funding bodies can also makes influence on the research area and its utility. Academic researches are produced in different states such as prototype, experimenting and ideas of new knowledge which can be utilized for different sort of issues. Coming sections comprised of detailed discussion about the results about the assessment of creation of utilized academic research done by selected cases is discussed in detail.

5.1.1 Academic Purpose of Research

Research can be produced to fulfill different academic requirements. Researches of selected cases which were utilized by end users have been produced for different academic purposes such as; "Self PhD thesis and students thesis reports", "Self Masters Thesis and Students thesis reports", and also in the form of "Research Project Reports". None of PhD faculty member argued about the utilization of academic research produced for purposes of research publications.

5.1.2 Funding bodies of Utilized Academic Research

Research done in the academic the academic environment is financed by different national and international funding bodies which directly or indirectly make influences on the research and its utility. Finding shows multiple funding sources of academic research utilized by end users. Research has identified that, larger number of utilized academic research is financed by public organizations at national level.

TABLE 1
FUNDING BODIES OF UTILIZED RESEARCH

National Organizations		International Organizations
Public Sector	Private Sector	
Environmental Protection Agency Sindh (EPA), Higher Education Commission of Pakistan (HEC), Ministry of Environment Pakistan, Parent University, Karachi Development Authority, National Institute of Oceanography Government of Pakistan, Water And Power Development Authority (WAPDA) Karachi	Sanghar Sugar Mill	International Union for Conservation of Nature and Natural Resources (IUCN), World Bank, European Union, United States Agency for Inter development (USAID)

5.1.3 Developmental State of Utilized Academic Research

Research finding shows that academic researches utilized by end users have been produced in the different states. Research

produced as an “idea” and “experimenting” shows larger number than other with 61.54%. Result shows less academic research have been utilized in state of “prototype”.

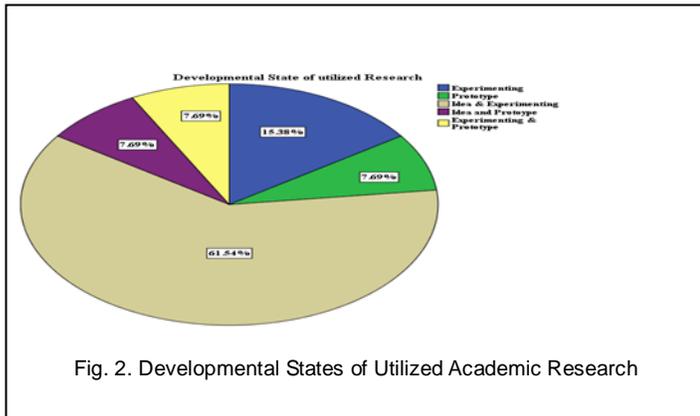


Fig. 2. Developmental States of Utilized Academic Research

5.2 Stage 2. Who were the End Users of Utilized Academic Research?

Academic research utilized by different practitioners must comprise of their relevant needs which makes absorptive capacity of the research. Research has found multiple type of end user organizations of academic research at national and international level.

Table 2
Research utilizing organizations

	National Organizations	International Organizations
Funding Organizations	Environmental Protection Agency (EPA) Sindh, Karachi Development Authority, Ministry of Environment, Water And Power Development Authority (WAPDA) Karachi, Sanghar Sugar Mill	International Union for Conservation of Nature (IUCN), United States Agency for International development (USAID),
Non-Funding Organizations	National Highway Authority, Motorway Police, France Government, Karachi Sewerage & Water Board, Climate Change Center GIS, Pakistan, Sindh Rural Development Department Government of Sindh (SRD), Thardip, Sindh Irrigation & Drainage Authority (SIDA), Water and Sanitation Agency (WASA), Ministry of Alternative energy Government of Sindh	Malaysian Government, UK Government, Thailand Government

At national level most of the research has been utilized by both funding non-funding bodies of academic research. Funding organizations of academic research at national level includes; “Water And Power Development Authority (WAPDA)”, “Sanghar Sugar Mill”, “Environmental Protection Agency (EPA) Sindh”, “Karachi Development Authority”, “Ministry of Environment Pakistan”. Research has been utilized also at international level by different funding and non-funding organizations such as; “France Government”, “International Union for Conservation of Nature (IUCN), Malaysian

Government, UK Government, Thailand Government. Detailed results are shown in table. 2.

5.3 Stage 3. How academic research was transferred to end users?

Academic research is transferred to end users through different channels of communication within the different states. Research findings have identified different channels of research knowledge transfer to end users using options of “yes” and “no”. Most of the academic research has been transferred to end users through personal links with the rganizations of academic research shown in figure 3. After using personal linkages for academic research transfer to end users; academic research has been transferred through other channels of academic research knowledge transfer such as; “workshops”, “seminars”, “conferences”, “trainings” and through “print/electronic media”. Findings have explored that very less number of research have been transferred to end users through research knowledge transfer offices and through “Higher Education Commission of Pakistan (HEC)” and “Pakistan Engineering Council (PEC) program”.

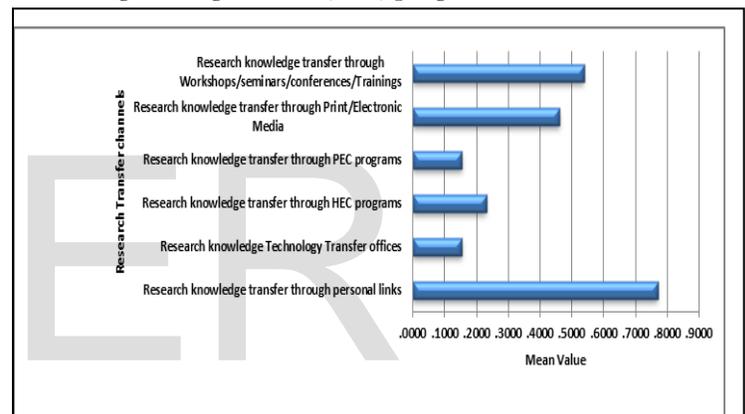


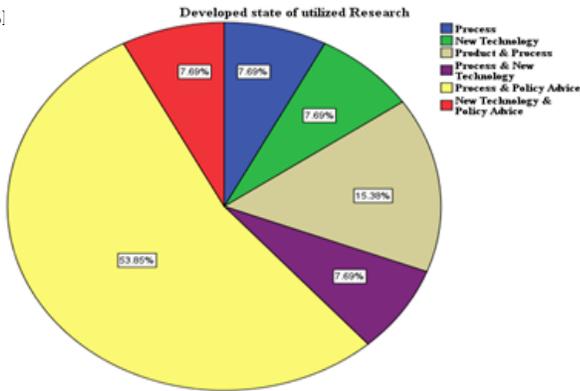
Fig. 3. Channels of Research knowledge Transfer to End Users

5.4 Stage 4. How academic research knowledge were utilized by End users

Academic research done within the academic environment can be developed as a product, process, new technology and policy advice. Every state of research needs different intellectual property rights. This section assesses developed state and intellectual property rights of utilized academic research produced by PhD faculty members in the field of environment.

5.4.1. Developed state of Utilized Academic Research

Outcomes of academic research done by PhD faculty members in field of environment have been found in different states. Though; larger numbers of utilized academic research have been produced in states of “Process & Policy advice” with 53.85% than products and processes with 15.38%. shown in figure 4. Very few numbers of academic researches have been utilized by end users in state of “New Technology” and “New Products”.



5.4.2 Intellectual Property (IP) of Utilized Academic Research

Intellectual property is the most common indicator for measurement of scientific and technological knowledge utilization for the development. Result shows more than half of the academic research has been utilized with intellectual property of “copyrights” at 53.85% shown in figure 5. Very few numbers of utilized academic researches have been identified with intellectual property of “Industrial Designs” and “Patents”.

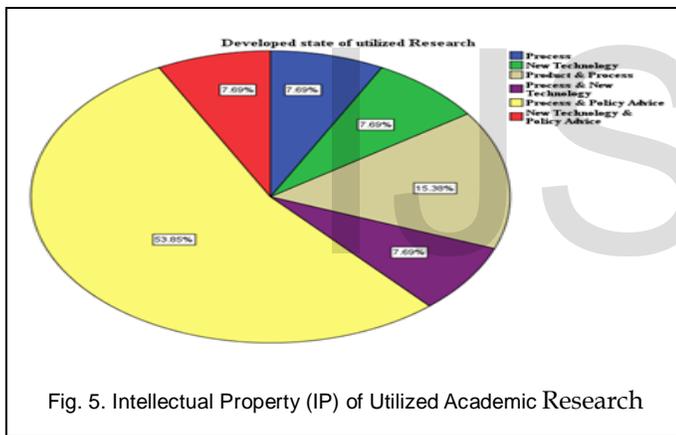


Fig. 5. Intellectual Property (IP) of Utilized Academic Research

5.5 Stage 5. Effectiveness of Utilized Academic Research

Effectiveness of utilized academic research are categorized based on different environmental issues. Research findings have explored, utilized academic research relevant to different environmental issues. Most of the academic research have been explored relevant to alarming environmental issues such as; ‘Municipal waste’, ‘Air Pollution’, ‘Sustainable Road Transportation’, ‘Coastal Management’, ‘Energy Crises’, ‘Global Warming’, ‘Solar Energy Production’, ‘Evaluation of Policy Impact on Energy Consumption’, ‘Green Energy Production’, ‘Protection of Biodiversity’, ‘Industrial Waste Management’, ‘Water Purification’, ‘Water Resources Management’, ‘Efficiency of Alternative energy Resources Utilization’, ‘Water Treatment’, ‘Drainage System Improvement’, ‘Biofuel Production’.

6. CONCLUSION

This research has developed five stage model for assessment of academic research utilization for development. Developed five stage model assess the utilization of academic research. It has been developed based on literature review and interviews with PhD faculty members in the universities in Sindh offering degrees in the fields of environmental engineering and environmental sciences. Using case study approach, this is one of the few exploratory studies to systematically consider assessment of academic research utilization for the development. Recent years have seen understanding of knowledge shift from “knowledge as a thing” which can be given and received towards “knowledge as a process” which evolves over time and is context specific [19], [20], [21]. First stage of model assesses the modes of knowledge creation in academia. The research argues that academic research is produced for different academic purposes such as thesis reports of masters and PhD degrees financed by both national and international organizations. Produced research comprised of different states such as experimenting, prototype and innovative ideas (stage 1). Most of the research has been produced as a experimenting and ideas with little number of researches in state of prototype. Research contributions have been utilized by couple of end user organizations for development. Larger numbers of research contributions were utilized by the funding bodies of such academic researches (stage 2). Most of the researches financed by the academic bodies such as Higher Education commission of Pakistan (HEC) were utilized by the non-funding organizations at national and international level. These findings suggests that research contributions financed by the HEC plays effective role for academic development but less focused for the development in terms of utility of research. Utility of academic research can be enhanced by making efforts for research targeted to development plans. Research has been transferred through personal linkages of researchers with the end users of academic research and the other most frequent is; through academic activities of knowledge transfer such as conferences, seminars and trainings (stage 3). Universities must focus to develop mechanisms of knowledge transfer for continue and effective academic knowledge transfer. Ensuring time is spent reflecting on how academic research knowledge is being generated and shared with end users. Research concludes that research contributions have been utilized in state of processes and policy advice at larger number with intellectual property and copyrights. Academic research has rarely been utilized in form of products and new technology with intellectual property of industrial design and patents (stage 4). Policy makers must focus towards the increase in the academic research utilization in state of products and new technology by promoting new startup companies and incubators for technological development in field of environment. Importantly, while the problem for which academic research is utilized, It explores the impact of research towards development in field of environment. Utilized academic research have provide solutions regarding to environmental issues in Sindh as providing renewable energy resources, providing solutions related to air and water resources (stage 5). Though end users

have utilized the academic research relevant to environmental issues in Sindh but still these issues needs to be solved. The capabilities of research producing organizations and infrastructure required for research utilization should be maximized for development.

For the assessment of practical applications of developed five stage model has been empirically applied on the research produced by the PhD faculty members working in the universities offering degrees in field of environment. It should help researchers, research funding bodies, policy makers and practitioners for the assessment of academic research utilization for development particularly in field of environment. Future research can be done by using proposed five stage model in other academic fields of study. Developed five stage model can also be used for assessment of research utilization produced by other national and international research organizations. Individual stages of developed research five stage model can also be used for the assessment of research utilization for development.

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