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Case Study

Evaluating the Status of Technologies Transferred to Users: Evidence at the University of Gondar, Ethiopia

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ABSTRACT

Increasing demands but lack of adoption for technologies are the key challenges of technology transfer. The level of utilization with improved technologies and advanced systems are limited. The objective of this paper was to examine the status of transferred technologies and to evaluate determinants that influenced the functioning of transferred technologies. This study is conducted at University of Gondar, Ethiopia. All 135 investigators who granted technology transfer projects between 2012 and 2021 were taken for the study. Participant observation, questionnaire, document review and focused group discussion were used for data collection. Descriptive statistics, qualitative narrations, and Binary Logit econometric model were employed for data analysis. The study results revealed that 11% of principal investigators were females. About 87.4% and 12.6% investigators were 2nd and 3rd degree holders, respectively. The proportion of soft and hard system granted projects were 44.4% and 55.6%. About 34.1% and 29.6% of the technologies were transferred and utilized to end users. About 13.0% of the adopted technologies have possibility of making business or startups and some of them can be used for manufacturing industries. The model results indicated that college types, year of granting, type of technologies and transfer, implementation and technology users are positively influenced the functioning of technologies while age of college and field distance negatively affected the utilization of technologies. Therefore, adequate time and budget, and data-base management systems are suggested for effective functioning and sustainability of transferred technologies.

Keywords: Innovation, linkage, system, technologies.

INTRODUCTION

Ethiopia is predominately relying on rain-fed agriculture and subsistence farming. Agricultural meccanization was started during Imperial era and advanced to state farms during

Derg regime after 'land to the tiller' is proclaimed in 1975 (Dereje, 2019). Since then, improved technologies have been introduced to the agricultural sector. Recently, technology generation and transfer is mandated to Universities with the broader approach (Marina, 2008) as teaching, research and community engagements are the key pillars of higher teaching-learning institutions. Some research outputs either transferred to community services or adopted to technologies. Hence, technology transfer is one of the focus areas of Universities that contributed to the national development and economic growth (Gokmen and Turen, 2013).

The University of Gondar (UoG) is established in 1954 as a Public Health College and Training Center. In 1979, it became Gondar Health College Training Institute. It is the earliest public health training institution in Ethiopia and then evolved to Gondar College of Medical Sciences in 1989. The college became one of the pioneer institutions of the country that has been produced competent medical doctors and health professionals. The college of medicine and health sciences is advanced to Gondar University College at University status in 2004. Currently, the university has eight colleges, two institutes and one school. UoG differentiated as one of the first generation universities in the country in 2022/23 academic year as nearly 20,000 students enrolled in 92 undergraduates, 197 post graduate, and 10 specialty and four sub-specialty disciplines in regular, extension, and summer-in service programs. At the moment, the university has five campuses, namely Gondar College (GC) for health sciences, Maraki for social sciences, Atse Tewodros for natural sciences, Atse Fasil for technology related fields and Teda for agricultural sciences.

It is widely recognized that UoG has played prominent roles for innovation, technology and knowledge transfer to solve societal problems at large. Currently, the UoG is set apart as Research University despite it is also engaged in technology transfer and community development activities. University-industry linkage and technology transfer (UIL and TT) is one of the directorates of the office that plan, organize, lead, manage, and control physical and financial resources and activities related to technologies, innovations, institutional linkages, internships, externships, intellectual properties, patents, and cooperative trainings. Adoption, adaptation, and customization of technologies and innovations are among major activities. Commonly, academic staff develop project proposals and get through evaluation processes by peer reviewers and college review and ethical committee with support of coordinators subsequent to paper calls. The UoG has granted several technology-transfer projects for investigators in collaboration with various institutions and organizations at local, regional, national and international levels.

Despite investigators have been designed, adopted and developed technologies, the technology transfer wing faced pertinent challenges such as lack of attention, lack of capabilities, inconsistent procedures, frequent changes of directives, inadequate linkages, insufficient office and equipment supplies, and increasing demands of communities towards ready-made technologies, materials and in kind supports. The innovative and creative capability of academia remain inadequate due to lack of laboratory chemicals, regents and equipment. The UoG tried to adopt, adapt, disseminate as well as utilize various technologies to meet the local and national development demands and overcome challenges so as to solve societal problems. Yet, most technologies developed, customized and adopted are not in line with the envisaged technology demands of end users and the development agenda of Ethiopia. As a result, the level of utilization with improved technologies and advanced systems is still at a very low stage. In Ethiopia, technology transfer and institutional linkages are very limited (Shimelis et al., 2021). Therefore, the objectives of this study were to examine the status of granted projects for technologies and to evaluate determinants that influenced the proper functioning and utilization of technologies.

TECHNOLOGY AND KNOWLEDGE TRANSFER IN ETHIOPIA

The notion of technology is documented since 200 years ago. Technology is a system created by humans that uses knowledge and organization to produce objects and techniques for the attainment of specific goals (Volti, 2009). The word techne in Greek is to mean skill and art (Shun and Caroll, 2017). Technology transfer is a process by which one party gains access to another's technical information and successfully learn and absorbs it into the production function (Wahab et al., 2012). Technology has physical and informational components. In this study, technology refers to a product, process or knowhow of demonstrable benefits obtained through research or invention, imported, adapted from abroad which can be disseminated or commercialized for public use (UoG, 2022).

According to systems dynamics theory, the combination of theory, methods and philosophy are essentials how things changing over time (Hamilton, 2020). The theoretical framework of the resource-based view and resource dependency theory enables to integrate human, physical and organizational processes. On the basis of this theory, research Universities like UoG need to reach systems for potential technologies, innovations and mechanisms for funding, commercialization and linkage with industries.

MATERIALS AND METHODS

Study descriptions

The study is delimited to UoG where different technologies and innovations have been developed and disseminated to end users. Innovators and technology adopters are principal and co-investigators. According to the UoG guideline, Principal Investigators (PI) is an academic staff of the UoG or any funding organization to direct the project or program supported by the fund. Whereas, Co-Investigator (Co-PI) is an academic staff or an expert and a member of a project with defined roles and responsibilities. Based on the nature of the project, either a technology can be deployed and used in the university or might be disseminated to intended end users for the surrounding communities. Essentially, the adopted or innovated technologies are disseminated either in terms of business or for free. Investigators have used different dissemination mechanisms for their knowledge and technologies such as physical apparatus, print media, and social media like television, radio and others. Articles, text books, books, teaching materials, modules, manuals, flyers, posters, leaflets, policy briefs, conference booklets, and trainings are also knowledge and technology dissemination tools.

Sampling, methods of data collection and analysis

Data, sampling and methods of data collection: This study is conducted in UoG where several technologies and innovations are developed and transferred. Both qualitative and quantitative data types collected from primary and secondary sources. Direct census was conducted by taking lists of investigators who granted technology transfer projects between 2012 and 2021. A total of 135 investigators were taken for the study. The data were collected between July and December 2023. The methods of data collection include participant observation, document review, questionnaire and one focused group discussion with 10 members. The group discussants were technology transfer coordinators.

Data analysis: Descriptive statistics, inferential tests (T-test and Chi-square), econometric model and narrative methods were used for data analysis. Binary Logit model was used to compute the dependent variable with independent variables using SPSS version 20. This model is preferred because it gives standard results for dichotomous choice estimation (Greene, 2007).

$$Logit(P_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_n X_{ni} + e_i \qquad (1)$$

where: P(i) is the probability that i^{th} value of the dependent variable, X is the i^{th} value of the independent variables, e_i is error term that the dependent variable is not explained by the independent variables, and n is the number of independent variables.

$Odds = \frac{P_i}{1-P}$, the probability of an event that will happen, that is, technology functioning divided by the probability of the event will not happen (the technology not functioning). Thus, the Logit (Natural log of odds) of the unknown binomial probabilities are modeled as a linear function of the X_i.

$$Logit(P_i) = Ln(\frac{P_i}{1-P_i}) = \beta_0 + \sum_{j=1}^{n} \beta_j X_{ji}$$

The model assumes that underlying stimulus index Logit(P_i) is a random variable, which predicts the probability of technology functioning. Pi is the probability of technology functioning, while (1-P_i) is the probability of a technology that was not functioning. Dependent and independent variables were taken for the study. The hypothesized dependent variable is technology functioning while independent variables are shown in Table 1.

Table 1: Hypothesized variables, descriptions and measurements of the status of technology

Acronyms	Descriptions	Type of variables	Units and measurements	Hypothesized sign
SEX	Sex of PI	Dummy	1=male, 0 otherwise	+(male)
EDU	Educational level of PI	Continuous	Educational status	+
COLLG	Name of colleges	Discrete	1 to 11	+(early)
YEAR	College established	Continuous	Years	-
GRANTYR	Project grant period	Continuous	Years	+
TTYPE	Technology type	Dummy	1=system, 2=hardware	+(hardware)
IMPL	Is technology implemented?	Dummy	1=yes; 0=otherwise	+
TRANSF	Is technology transferred	Dummy	1=yes; 0=otherwise	+
PICHANG	Was there PI Change	Dummy	1=yes; 0=otherwise	-
USER	Users	Dummy	1=yes; 0=otherwise	-
COTURN	Coordinators turnover	Continuous	Number of turnovers	-
ASTAF	Academic staff size	Continuous	Number	+
DIST	Distance between UoG and technology users	Continuous	Km	-

Dependent variable: It is the status of technology whether functioning or not. It is dummy variable with a value of 1 if the technology is functioning or utilizing the end user or zero otherwise.

Independent variables: Year of principal investigator's experience, level of education for the investigator, communication or coordination and staffing are independent variables used in the study of Hamilton (2020). The variable for years of foundation, technology policy, resources, reward and networking are found in the study of Gallego et al. (2009). These variables have the possibilities of influencing adoption of technologies (Groher et al., 2020). Sex and distance are potential explanatory variables in most technology adoption studies. The remaining independent variables are operationally and contextually adopted by focused group discussion. Multicollinearity test was employed for continuous variables for its inter correlation using Variance Inflation Factor (VIF), and the values of VIF are less than 10. Similarly, Contingency Coefficient was used to test discrete variables. There was no strong association among dummy independent variables with the dependent variable and its values are less than 0.75 as stated by Greene (2008). Hence, in both cases, there was no multicollinearity problems.

RESULTS AND DISCUSSION

Overview of technology transfer projects and the major attributes of investigators

In the UoG, technology transfer projects were not granted before a decade (Haimanot et al., 2014). The technology transfer office was established in 2012 and since then technology transfer projects have been granted and implemented. Despite female academicians were participated in technology transfer projects, their participation in terms of number was limited and the proportion of female investigators was 11.0%. The majority (89.0%) of investigators were males as the ratio of female academic staff was lower than their male counter parts in the UoG. Nevertheless, females have participated both in scientific decision making process and engagements in academic expertise. The educational level of investigators were Master and PhD holders. Nearly, 87.4% of investigators were master of sciences or arts while the remaining 12.6% were PhD holders.

Table 2: Correlations and associations among independent variables.

Variables	Adopted (N=40) Mean	Non-adopted (N=95) Mean	T/X^2 values	P-values
Age of college, years	2006.68 (13.76)	2002.53 (16.57)	-1.408	0.161
Grant period, years	2018.23 (1.97)	2017.53 (2.04)	-1.839	0.068
Coordinator turnover, number	1.68 (1.12)	1.64 (1.64)	-0.116	0.908
Academic staff, number	136.18 (84.27)	266.55 (307.89)	2.493	0.014
Distance, km	24.58 (35.38)	29.59 (47.68)	0.599	0.550
Educational level	2.15 (0.36)	2.12(0.32)	-0.544	0.588
Sex of investigators †			0.135	0.039
College where investigators belongs †			0.373	0.005

Technology types †	0.216	0.010
Technology implementation †	0.348	0.000
Technology transfer †	0.441	0.000
PI change †	0.045	0.598
Technology users †	0.014	0.875

Note: *, **, *** indicated for 10, 5, and 1% significant level; denoted to discrete variables; figures in brackets are standard deviations

The T-test was employed to show the correlation of continuous independent variables while Chi-square was employed in order to reveal the association of discrete variables (Table 2). The T-test showed that recently granted technologies were functional compared to previously granted technologies. The size of academic staff was positively correlated with technology functioning. The Chi-square test revealed that the sex of investigators, college types, type of technology, implementation and transfer had significant associations with the functioning of technologies. Functional technologies were disseminated relatively at near distances. The minimum and maximum distance of technology transfer took place were 0.5 and 177 km, respectively.

Technology transfer

The center, institute, college and University statuses were established between 1954 and 2016. During the study period, the number of colleges, institutes and school were 8, 2 and 1, respectively. Medicine and health sciences is the first established college in UoG while the latest is institute of biotechnology. Academic staff in the college of education and institute of biotechnology were not participated in technology transfer projects as PIs. Almost one-fifth of the total investigators were from institute of technology followed by college of informatics and vet medicine and animal sciences. The trend of granted projects are shown in Figure 1.

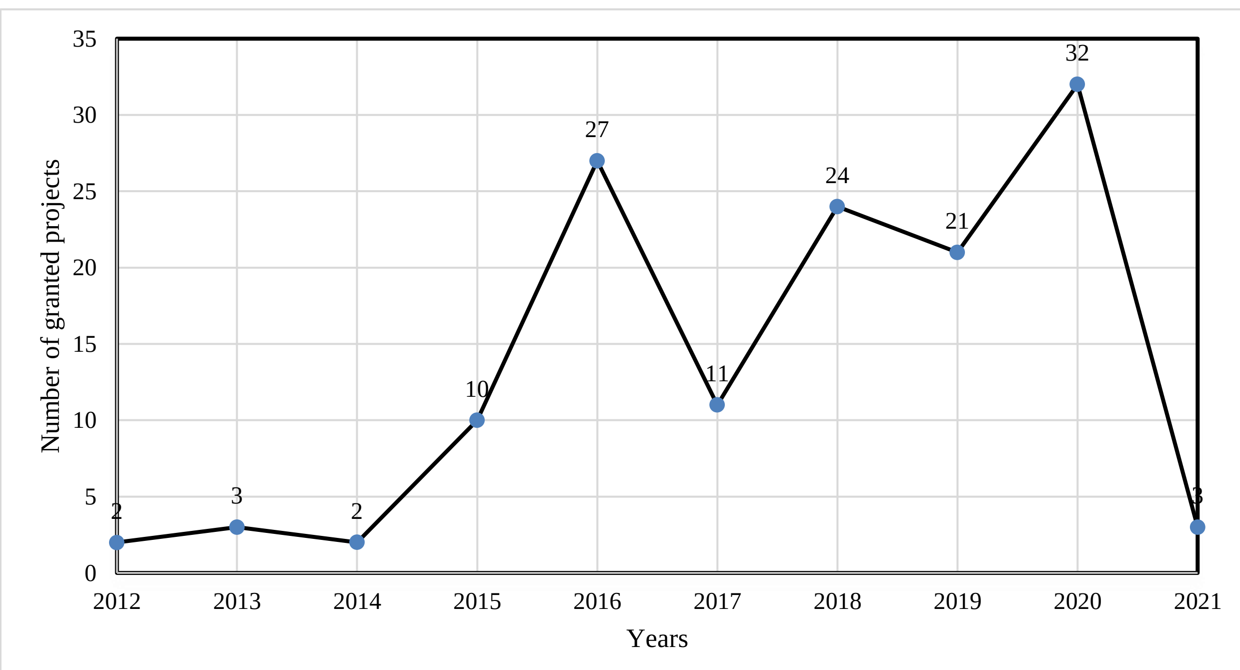

Figure 1: Granted projects (2012-2021).

SOIL: Soil fertility enhancement and organic waste management activities were practiced in different farming communities. Organic fertilizer, and soil and water conservation technologies are implemented in Gondar Zuria district with the support of the UoG. Among organic fertilizers, vermicomposting was prepared and used to enhance the fertility status of soils for which tef crop was grown. Asenia fotidea is among worm species adapted to poultry feeds that transferred to users in Gondar city and Gondar Zuria district. Soil fertility amelioration measures compost, terraces, farmyard manure and tree planting were implemented and adopted after trainings and awareness creation (Kassaye and Abay, 2019).

Herbs: Since 2016, the school of pharmacy of the referral hospital of UoG, has compounded different herbs for treatment of patients. A study conducted by Abebe et al (2018), 62% of households are herbal medicine users. In Dembia district of central Gondar zone, more than 24 plants were identified for malaria treatments (Abyot, 2013).

KGE: Different trainings were delivered to high-tech knowledge demanding skills such as software application and 3D printing machines to poly technic instructors and university teachers. Digitizing of church manuscripts and creation of electronic archives are among knowledge-based technologies developed in the UoG. Nearly 39.0% of the students in the Universities never used electronic communication devices in the beginning of 2010s (Solomon et al., 2013). Currently, more than 75.0% students access at least mobile phones for communication. High school and university students used mobile phones and internet so as to work out educational related assignments and knowledge development.

IRRIGATION: Water use efficiency can be applied using different schemes such as drips, pumps and river diversion for market oriented crops. Waste water treatment system and water storage tankers were designed and fabricated. In Ethiopia, improved water harvesting technologies including hand-dug wells, trapezoidal, doom, hemispherical, and bottle neck-shape structures; drip systems, and different water pumps were introduced to Ethiopia since 2002 (Wuletaw, 2011). However, most of water harvesting structures were not successful and were not used for intended purposes (Giordano et al., 2012). It is only 15.6% of households adopted irrigation technologies in North Shewa, Ethiopia (Solomon et al., 2021). In contrast, farm households have high demand of water for irrigation and nearly 98.0% of sampled households are willing to pay for sustainable irrigation water supply (Agerie et al., 2022.

PHT: The estimated post-harvest loss for cereal crops in Ethiopia is 30-50% (Dubale, 2018). Hence, post-harvest technologies are essential to minimize such types of losses. Investigators of UoG constructed post-harvest technologies for potato storage and cooling chamber for tomatoes at Teda campus and Woreta town, respectively. An indigenous knowledge technology was also adopted for maize stock borer protection. Recently, the UoG introduced tractors and combine-harvester to improve pre-and post-harvest loss of crops. A team of experts developed a multi-purpose agricultural machine in the University. However, the machine was not completed so that did not transfer to end users.

CROPS: Improved crop varieties are disseminated to users. Improved maize variety, locally selected food barley, improved malt-barley and improved tef crop varieties are promoted to rural households in Dabat, Wogera, and Central Gondar districts. Hybrid vegetable varieties such as water melon (Polimore and Lahat F1), red onion (Sivan F1 and Red Coatch), and tomatoes (Galilea and Shanty) were popularized and demonstrated to forty farmers at west Gondar, Dembia and for about 150 University staff at farm center around Shinta river near to Tewodros campus of UoG. Mushroom was introduced and transferred to youth groups in Gondar city. Nevertheless, it was not sustainably adapted and adopted. Agricultural technologies mainly chemicals (fertilizers, pesticides and herbicides), improved seed varieties, and animal breeds are copied to technologies. University researchers adopted these technologies to enhance crop and livestock systems. Several researches have released numerous improved crop varieties in the country as well so that the trends of yield increment are improving (Getachew and Tigabu, 2019).

ENERGY: Investigators adopted prototypes on solar systems for different purposes. Solar photovoltaic–based electrification was introduced to Denkez public school and the surrounding village in Gondar Zuria district. Heat controller, biogas, and wind powered water lifting systems are among adopted energy related technologies. Wind turbine is also one of the disrupting energy sources. A study conducted in West Shewa, Ethiopia revealed that 41.4% of the rural households used modern technologies like the solar renewable energy (Seble and Amenu, 2021). In Ethiopia, the major sources of energy include hydro-power, solar, wind, geothermal, wood, agricultural waste and biogas (Ashebir and Desta, 2020).

DEVICES: Despite machines are devices, the latter are simple equipment and materials fabricated for different purposes. Investigators adopted cross bicycle, health rider, door opener, splitter, mechanical ventilator, sample collection booth, disinfectants, masks, IV-stand, hand and pedal operated washers, and dispensers. Innovators fabricated different devices in different countries like projector, computer, magnetic white board, audio-visual centers, digital library, smart board, iPad, video conference systems, desk top, lap top and many others which can enhance quality education (Nwabuez et al., 2019). Technologies help for research, teaching, communication, Facebook, entertainment, discussions, and learning management systems (Irum et al., 2018). The majority of technology devices are fabricated from abroad and improved through business companies to Ethiopia.

MACHINES: Various machines were designed and fabricated by university investigators. Some of the machines implemented in the University include juice extraction, metal bending, species grinder, butter churner, dental care, onion peeling, sand sieving, animal feed chopper, tef row planter, and bone crusher and multipurpose agricultural machines. Among listed machines, feed chopper is fabricated and transferred to farm households and it has been used for livestock feed chopping. Similarly, high school students trained at Science, Technology Engineering and Mathematics (STEM) in UoG were participated in national innovation competitions by Robotics and other prototype innovations in 2020 and 2021. Now-a-days, elementary, high school and university students are aware of innovations and technologies. In UoG, innovators adopted drone, 3D products, and renewable energy sources like wind energy machines. These are among disruptive technologies (Valavanidis, 2020).

MOBAPPS: It refers to different mobile applications implemented for various purposes using smart phones. Mobile apps are adopted for city guide, tourist counting and tracking, enabled to formulate animal feed stuff, access information on life skills and code of conduct for university students and teachers and to classify some human diseases. A technology adopted for mobile app can send short messages to customers like blood donors. It also manages information, for example team training program, and health care systems such as mental and diabetics. Mobile applications have benefits on multimedia, productivity, travel and utility for communication. Rules of the game is accessed through mobile apps that have wide application for social net, weather, news, sports, banking, map, movie, retail, search, and photos a/videos. According to the study of Islam et al

(2010), games, weather, maps, and social networking are the most prevalent uses of mobile apps at global level.

ANIMALS: Technologies related to animals were implemented to improve livestock production and productivity. The adopted technologies include poultry hatchery, bee transporter, feed treatment, fish management, artificial insemination, and synchronization for dairy cows, dog handling tools, hen brooder box, equine welfare, animal restraining techniques, animal feed improvement, sericulture and aquaponics. Manure removal, milking and cooling are also essential technologies adopted for animal production (Mazur and Romaniuk, 2015). Artificial insemination and improved feed mainly for dairy cows are demand driven technologies (Okello et al., 2021). A team of investigators in the college of medicine and animal sciences disseminated dog restraining technologies with full packages. Dog muzzle masks, dog catching nets, and dog restraining crush are designed, implemented and transferred to end users to vaccinate and eradicate mass canine rabies (Anmaw et al., 2022).

WEBSITES: These technologies are implemented to serve customers such as students, tourists, teachers, and stakeholders. Similarly, some websites were developed to manage data and information of projects, publications, journals, laboratory materials, university apartments, health insurance systems, budget, disease surveillances, and more related activities. The UoG has server space for different websites and webpages including student enrolment and placement, grade recording, project management, and others. Websites enable to improve services and possibility of communication with several organizations, institutions and individual customers (Gallego et al., 2009). Websites can disrupt the conventional and manual services of organizational systems.

The author has personal observation related to technology granting, implementation, transfer and monitoring and evaluation phases of granted projects. A focused group discussion was also employed mainly for two reasons. In order to contextualized explanatory variables and select potential innovations and technologies for commercialization. Various technologies were designed, adopted and adapted by University researchers. Among granted and transferred technologies, discussants have selected potential technologies for business startups. These technologies include manufacturing of machines, web-based digital systems, innovations, and technologies related to indigenous knowledge. Manufacturing technologies include paper recycling, plastic rope and broom making from waste plastic bottles, water storage tanker, honey bee colony transporter, wheel chair for disable persons, sand sieving, feed chopper and grinder, organic fertilizer maker and maize Sheller machines. Project information management, student information management and student placement are web-based systems. Recovery of power storage capacity of lap top computer batteries are patented innovated technologies. Pharmacy compounding, honey wine production, and organic fertilizer production like vermi-compost and water hycine are indigenous related technologies. The 3D printing such as different letters, symbols, numbers, devices, and other technology inputs are identified for business startups. It is, therefore, about 13.0% of the granted technologies are possibly selected for business startups.

Determinants of technology transfer

The Binary Logit model was applied for analysis. The Omnibus test of goodness of fit in Chi-square indicated that null hypothesis has determined that the step was justified. When the step is to add a variable (s), the inclusion is justified if the significance of the step is less than 0.05. Had the step been to drop variable(s) from the equation, the exclusion would have been justified if the significance of the change was more than 0.10. Therefore, the likelihood ratio of Chi-square of

80.09 with a p-value of 0.000 shows that the outcome model as a whole fitted significantly. The overall model was significant and good fit.

Table 3: Model results.

Variables	B^2	S.E.	Wald	Sig.	Exp(β)
Sex	-1.706	1.408	1.468	0.226	0.182
Education	0.002	0.887	0.000	0.998	1.002
College types	1.740***	0.659	6.960	0.008	5.696
College establishment period	-0.246***	0.091	7.319	0.007	0.782
Grant year	0.472***	0.166	8.061	0.005	1.603
Technology type	2.025**	0.929	4.747	0.029	7.575
Implementation	18.837***	6017.765	0.000	0.998	151*106
Technology transfer	2.668***	0.819	10.619	0.001	14.418
PI change	1.275	1.058	1.452	0.228	3.580
Tech users	0.104**	0.860	0.014	0.904	1.109
Coordinator turnover	-1.401	0.773	3.284	0.070	0.246
Academic staff size	0.002	0.003	0.336	0.562	1.002
Distance	-0.016*	0.009	2.991	0.084	0.984
Constant	-490.602	6028.275	0.007	0.935	0.000

Thirteen variables were entered to the model. The college types, years of college establishment and granting period, type of technology, implementation, technology transfer and accessed to users were significant variables. The scope of the study in terms of area coverage addressed the surrounding up to 77 km away from the university. The study technologies included years between 2012 and 2021.

College types: The model results were statistically significant at 1% (P=0.008) showing a positive relationship with functioning of transferred technologies. The reference college is the college of medicine and health sciences. Projects granted at central, college of informatics, college of agriculture and environmental sciences, institute of technology were functioning well compared to projects granted to college of medicine and health sciences, business and economics, social sciences and humanities and natural and computational sciences with odds ratio of 5.696. The nature of management level being central or recently established colleges, fixing other independent variables constant, the likelihood of technology functioning increases by nearly sevenfold. This result is supported by other findings. The technology-organization-environment nexus is extensively used for technology adoption (Dube et al., 2020). Technology adoption is directly correlated to with the performance of working unit or company performance (Mustafa and Taakub, 2018).

Age of college: It is statistically significant at 1% (P=0.007) showing a negative relationship between age of college establishment and functioning of technologies at a coefficient value of -0.246. The odds ratio of 0.782 indicates for the years of college establishment implies that earlier established colleges had low chance of technologies to be functional, which declined by sevenfold while fixing the value of other independent variables.

Years of granting: It is statistically significant at 1% (P=0.005) showing a positive relationship between year of a project grant and functioning of technologies. It implies, as a granting period increases by a year, holding other independent variables constant, the likelihood of functioning technologies increases by odds ratio of 1.603. The probable reason for this finding might be the function of several reasons. The cost of materials for technology fabrication were relatively low-cost in previous years compared to the current material prices. Moreover, technology adoption needs more time for its acceptance and proper functioning.

Type of technology: The model result showed that the type of technology was statistically and positively significant at 1% (P=0.029). As technologies being hardware like machines, devices, breeds, seed varieties, and similar technologies, the chance of technology functioning increases by the odds ratio of 7.575. For the type of technology, fixing other independent variables constant, the likelihood of technology functioning increases by four times compared to soft system related technologies.

Technology transfer: As expected, the probability of technology functioning of disseminated technology increases, under citrus paribus, with technology transferred to end users. As technology transferred, the chance of functionality increases with odds ratio of 14.418. Hence, the relationship between technology transfer and technology functioning was positive and significant at 1% (P=0.001).

Turnover of coordinators: In this study, coordinators refers to university-industry linkage and technology transfer coordinators of a given college or institute. Coordinators facilitate the overall activities of technologies and industry linkages. This variable is correlated with technology functioning negatively and significantly at 10% (P=0.070). As turnover of coordinators increases by one, the likelihood of functioning technologies declines by the odds ratio of 0.246. Hence, personnel turnover, has negative impact on management of technologies (Karna et al., 2020).

Distance: This variable has negative and significant correlation with technology functioning at 10% (P=0.084). As distance from University to the end user increases by one km, the chance of functioning of technologies decline with odds ratio of 0.984.

CONCLUSION

Implementation and management of projects of the UoG has long procedures. Call for papers, proposal development, proposal submission, proposal evaluation, proposal approval, getting ethical clearance, budget allocation, granting, project agreement, financing, implementation, reporting, monitoring and evaluation are among the key procedures of project management. As the technology tested or completed, it can be transferred or disseminated to end users on the basis of approved project proposals. In the meantime, other unintended circumstance, such as grievance, complains, project termination, principal investigator changes and others might happen and need to manage accordingly. These all are documented in the recently approved UIL and TT guideline of UoG.

Technology transfer is one of the sub-pillars of university mandates. UoG is established before 68 years and currently it runs 303 academic programs organized in five campuses. Despite the UoG has numerous achievements, the organization went through several challenges and bottlenecks. The status of technology adoption and adaptation is still at infant stage. Despite the UoG is established in 1954, technology transfer was carried out for the past ten consecutive years until this data collection took place. During this period, 135 projects were granted, of which 34% and 30% were transferred to end users and well-functioning, respectively.

A variety of technologies are adopted both in soft and hard system of a total granted technologies nearly 13.0% can be linked to businesses or commercialization and startups. Centrally funded projects and projects granted to recently established colleges were better functioning compared to college level granted and older colleges. On the other hand, recently granted technologies were not functioning as to previously transferred technologies. It implies that time is a key factor for technology adoption. Technology transfer is directly and significantly correlated with technology adoption. Therefore, emphasis should be given to college management and its excellence, adequate time of implementation, and transfer to end users is very crucial for the proper functioning and successful adoption of technologies. Turnover of coordinators and long distance adversely affected the functioning of disseminated technologies. Hence, either the frequency of turnover for coordinator and distance has to be minimized or proper handover system or data-base management has to be established.

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Declarations

Conflict of Interest: The author declared that he has no conflict of interest.

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