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Zimbabwe Economic Policy Analysis and Research Unit
ZEPARU

YOUTH EMPOWERMENT and Entrepreneurship through TECHNOLOGY TRANSFERS

RESEARCH TEAM:
Dr Gibson Chigumira
(Team Leader, Executive Director, ZEPARU)
Mr. Cornelius Dube
(ZEPARU Senior Research Fellow)
Mr. Wellington Matsika
(ZEPARU Research Fellow)
Mr. Lloyd E. N. Nyemba (Pr.Eng)
(Consultant)

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ACRONYMS

AAMines	African Associated Mines
ACBF	Africa Capacity Building Foundation (ACBF)
CNC	Computer numerical control
CSC	Cold Storage Company
CUT	Chinhoyi University of Technology
CZI	Confederation of Zimbabwe Industries
ECZ	Engineering Council of Zimbabwe
EISAZ	Engineering Iron and Steel Association of Zimbabwe
EMA	Environmental Management Agency
HIT	Harare Institute of Technology
ICT	Information and Communication Technology
IDBZ	Infrastructural Development Bank of Zimbabwe
IT	Information Technology
JBC	Jacob Bethel Cooperation
MoHTESTD	Ministry of Higher and Tertiary Education, Science and Technology Development
MoIC	Ministry of Industry and Commerce
MoSMEs	Ministry of Small and Medium Scale Enterprises and Cooperative Development
MoYIEE	Ministry of Youth, Indigenisation and Economic Empowerment
MSU	Midlands State University
NEC	National Employment Council
NUST	National University of Science and Technology
R&D	Research and Development
REA	Rural Electrification Agency
SIRDC	Scientific and Industrial Research and Development Center
SMEAZ	Small and Medium Enterprises Association of Zimbabwe
SMM	Shabani Mashava Mines
UNICEF	United Nations Children's Fund
UZ	University of Zimbabwe
YDECF	Youth Development and Employment Creation Fund
YEETT	Youth Empowerment and entrepreneurship through technology transfer
ZACE	Zimbabwe Association of Consulting Engineers
ZEPARU	Zimbabwe Economic Policy Analysis and Research Unit
ZERA	Zimbabwe Energy Regulatory Authority
ZIE	Zimbabwe Institution of Engineers
ZIMDEF	Zimbabwe Manpower Development Fund

EXECUTIVE SUMMARY

This is a report for the pilot project on youth empowerment and entrepreneurship through technology transfer (YEETT) which was funded by the Africa Capacity Building Foundation (ACBF) to inform and assess the effectiveness of developing youth empowerment models that leverage on technology transfer. The project was motivated by the co-existence of high unemployment of well-trained youth population and high technology gaps in the country, suggesting (i) an underlying fundamental problem either of mismatches between the skills possessed by the youths and what modern industry requires of them, or (ii) weak youth empowerment interventions and policies which fail to capacitate the youths to form their own businesses, replicate, uptake and utilise technologies they are technically familiar with in their own enterprises.

The objectives of the pilot project were to: (i) promote technology transfer and adoption; (ii) facilitate linkages between technology suppliers, financial institutions and the youth exposed to current technology and production processes; (iii) contribute to knowledge on alternative and innovative models of youth empowerment; (iv) empower the selected youth with entrepreneurial and technological skills; (v) assess the relevance and effectiveness of existing technology training and manpower development programs; and (vi) match skills of trained and unemployed youths to appropriate technology. The pilot project also sought to inform policy makers on the suitability and effectiveness of the country's skills training systems and prospects of a youth empowerment model based on technology transfer in addressing the high youth unemployment among the trained youths.

The pilot project demonstrated that attaching interns at companies that employ technologies that are relevant to their training helps to promote technology transfer and adoption as the interns were able to develop innovative products and solutions for the firms hosting them and willing to explore more outside the tenure of the pilot project. The pilot project also demonstrated that there is need for a longer implementation period to successfully facilitate linkages between technology suppliers, financial institutions and the interns. The project revealed that most firms no longer fund R&D and mostly rely on outdated manual systems, and internships are a win-win arrangement whereby hosting firms enhance their productivity by engaging trained unemployed youths for problem solving and innovation, while the youths benefit from being exposed to technologies which empower them. Although the youth got technological skills through the pilot project, there was no adequate time for them to develop entrepreneurial skills. In terms of the relevance and effectiveness of existing technology training and manpower development programs, the project found out that although training institutions lack facilities for imparting practical skills, the training they received was adequate for them to adopt and adapt to the hosting firms' technologies they were exposed to. The project demonstrated that through matching the trained unemployed youths to firms with relevant technologies to their training, the youths can learn and quickly adapt to the technology in use.

The pilot project revealed that if appropriately structured, it is possible to enhance entrepreneurship and empowerment through technology transfer by implementing a similar model. However, the following are some of the critical issues for such a model to have higher chances of success compared to the current model:

- There is need for a longer internship period compared to the three months in the pilot project. It was noted a project length of six to twelve months would suffice.
- The project idea needs to be communicated well in advance to all the stakeholders that are expected to have a role to play in enhancing its success and the entrepreneurship preparations should commence with the internship, so that the intern is adequately prepared to conceive proper ideas which can be easily bankable to ensure that the technological knowledge gained is used to advance entrepreneurship.
- Intellectual property rights need to be carefully incorporated into any similar project to ensure that those who have a role to play in the development of the projects and products are adequately protected.
- It is important to develop networks and data bases of potential interns and firms that offer placement to the interns.
- It is important for any future project to ensure that there is insurance risk cover for the interns.

- It is recommended to ACBF to consider supporting a full blown project on Youth Empowerment through Technology Transfer. This project can be spearheaded by ZEPARU and implemented in partnership with multiple stakeholders, including Business Membership Organisations; Ministry of Youth Indigenisation and Economic Empowerment; other Development Partners; Training Institutions and the Participating Firms.

- There is also need to explore ways of building a revolving fund that will help institutionalise support for youth empowerment and entrepreneurship through technology transfer and expand the number of beneficiaries given the extent of unemployment among youth with technology training.

1. INTRODUCTION

1.1 Background and rationale

There have been several studies to date focusing on empowerment in general, which all provide useful empowerment models that can be used to enhance the quality of life for all people[1]. Jennings et al (2006) defines empowerment as an outcome where individuals, families, organizations, and communities gain control and mastery, within the social, economic, and political contexts of their lives, in order to improve equity and quality of life. In the same manner, youth empowerment occurs when youths have control of their lives in terms of equity and quality of life.

Jennings et al (2006) also identify and discuss about four youth empowerment models which can be adopted to improve different aspects of youths' lives. Two of the models are mostly focused on youth relations with the society while the other are more oriented towards economic sustenance. The latter include the Transactional Partnering Model, which conceptualises youth empowerment as a mutual process of transactional partnering between adults and youth, with adults creating an empowering and welcoming environment while the youths engage in different empowerment initiatives. Also included is the Empowerment Education model, which emphasizes the development of skills and knowledge that support youth efforts.

Central to youth empowerment is economic self-sustenance. While employment opportunities for youths are important in enhancing economic sustainability, the level of control for the youth becomes limited, hence cannot be regarded as fully empowered. Sustainable youth entrepreneurship is therefore often regarded as one of the main channels through which economic sustenance can be pursued. Chigunta (2002) defines entrepreneurship as the practical application of enterprising qualities, such as initiative, innovation, creativity, and risk-taking into the work environment (either in self-employment or employment in small start-up firms), using the appropriate skills necessary for success in that environment and culture.

While there are several business initiatives that use limited technology, there is need for continuous innovation and application of technology for a business venture to become sustainable. Technology can be defined as the science or study of the practical industrial arts (Bozeman, 2000). Although education is a key aspect in technology uptake, technology can also be imitated based on experience and exposure. The movement of know-how, technical knowledge, or technology from one organizational setting to another is known as technology transfer (Bozeman, 2000). Technology generally is transferred from different sources, which include private sector firms, government agencies, universities and other technology research institutions.

The project focuses on empowerment and entrepreneurship through such technology transfer, focusing on youths. Youths constitute about 60% of the total 13 million people in the country (UNICEF, 2015). However, youth unemployment remains high in Zimbabwe due to a generally high unemployment rate for which the youths constitute the greatest share. Most of the country's youth population is either totally unemployed or are in low quality informal sector jobs where their potential as measured by their education level is being grossly underutilised.

The government has tried to respond to the youth situation through a number of empowerment programmes and initiatives through the Ministry of Youth, Indigenisation and Economic Empowerment (MYIEE); Ministry of Small and Medium Scale Enterprises and Cooperative Development; as well as the Ministry of Women Affairs, Gender and Community Development. However, it is mainly through the MYIEE that youth empowerment programmes were championed, especially through the Youth Development and Employment Creation Fund (YDECF). The YDECF, finances youth entrepreneurship development through loans at a concessionary rate of about 10% for tenure of up to 36 months depending on the nature of the project. The MYIEE has been able to come up with arrangements with financial institutions to come up with different youth funding programmes, and participating financial institutions include the following:

[1]Examples of such studies include Freire (1970), Pinderhughes (1995), Wallerstein (1992), and Zimmerman (2000)

- CBZ Bank Limited through the Youth Empowerment Fund;
- Infrastructural Development Bank of Zimbabwe (IDBZ) through the Youth Development Fund and the Meikles Out Grower Scheme;
- CABS through the Kurera/ Ukondla Youth Fund; and
- Stanbic Bank Zimbabwe through the Youth Wealth Creation Fund.

This pilot project, which was funded by the Africa Capacity Building Foundation (ACBF),aimed at developing a model of youth empowerment through technology transfers and assessed the appropriateness and effectiveness of the model for the Zimbabwean economy. The project sought to identify skilled but unemployed youths, matching them with technologies in production processes similar to what they were trained in and evaluate the post-matching outcome of the project with respect to technology replication, transfer and new entrepreneurship by the youths.

The co-existence of high unemployment for a well-trained youth population and high technology gaps in the country suggests an underlying fundamental problem either of mismatches between the skills possessed by the youths and what modern industry requires of them, or of weak youth empowerment interventions and policies, which fail to capacitate the youths to form their own businesses, replicate, uptake and utilise technologies they are technically familiar with in their own enterprises. Ultimately, therefore, the project sought to inform policy makers on the suitability and effectiveness of the country's skills training systems and prospects of a youth empowerment model based on technology transfer in addressing the high youth unemployment among the trained youths.

This report provides an evaluation of the pilot project, focusing on the outcomes as well as other areas that would need attention to replicate the pilot project in other areas or even countries.

1.2 Project objectives

This pilot intervention project sought to develop appropriate youth empowerment and technology transfer models for Zimbabwe. Its specific sub-objectives were:

i. To promote technology transfer and adoption;

ii. To facilitate linkages between technology suppliers; financial institutions and the youth exposed to current technology and production processes;

iii. To contribute to knowledge on alternative and innovative models of youth empowerment

iv. To empower the selected youth with entrepreneurial and technological skills;

v. To assess the relevance and effectiveness of existing technology training and manpower development programs;

vi. To match skills of trained and unemployed youths to appropriate technology

1.3 Methodology

The project targeted former students at Universities and Polytechnic colleges who have graduated but have the potential to be innovative and produce products that can be used productively. The preferred students were those that were unemployed and thus whose potential was being put to waste. These unemployed youth graduates were to be engaged for three months at firms that was using technology similar to what they have been exposed to in their educational training. The first part of the project was thus to identify the students as well as the firms which would be willing to attach them for the short period[2], hence a stakeholder mapping and engagement exercise was undertaken.

[2] The short time frame proved to be the main challenge as many firms were not prepared to host the interns for only three months.

1.3 Stakeholder engagement

Stakeholders engaged included training institutions as well as firms for buy-in into the pilot project. The results of the engagement process can be described as follows (Table 1):

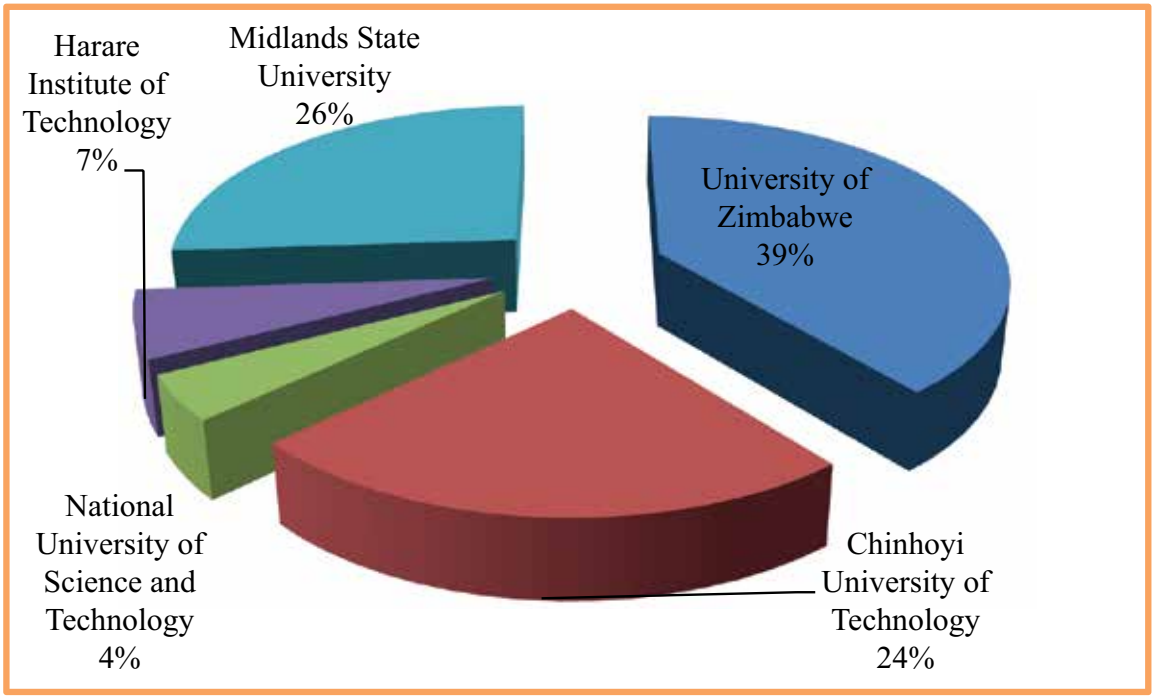
Table 1: A brief summary of stakeholder engagement outcomes

	INSTITUTION	ISSUES COMING OUT
1	Masvingo Polytechnic	The project idea did not generate much interest with the institution. As a result, attempts to get any former students with projects which could be engaged in the program were not successful during the meeting as well as in subsequent follow ups.
2	Midlands State University	There was a great interest from the institution and a high level of cooperation. MSU also had ideas on how this could be taken up to a higher level and expressed their willingness to participate in the pilot project. A list of former students as well as possible institutions under which they could be placed was obtained from MSU.
3	Gweru Polytechnic College	There was an expression of interest in the project. The ZEPARU team was also shown a sample of the projects which students had done to show their innovativeness. However, attempts to later get in touch with the students were not successful, as the interest in the project appeared to have waned off, especially due to the short term nature of the attachment and concerns with intellectual property rights.
4	Kwekwe Polytechnic College	Although there appeared to be some interest, attempts to get cooperation later on, especially with respect to potential students and their projects were unsuccessful.
5	Harare Polytechnic College	Although interested in the project, cooperation was affected by their reservations over the short time frame as well as failure to appreciate direct benefits to the institution.
6	University of Zimbabwe	The institution welcomed the project and was very cooperative in sharing the names of potential students as well as their projects to help in matching them with the potential firms for internship.
7	Harare Institute of Technology	HIT was also excited about the project and cooperated well in providing a list of unemployed graduates from their institution along with their final year projects.
8	Engineering Iron and Steel Association of Zimbabwe	The institution bought into the idea and was very excited about the project. It was mainly through the association that most firms were mobilized.
9	African Associated Mines Technical Training Institute	The African Associated Mines (AA Mines) is part of the Shabani Mashava Mines (SMM Holdings). AA Mines is getting ready for initiating operations at Mashava mine and has been able to have a database of engineering student graduates who are employable as mining engineers. They were excited about affording unemployed graduates the exposure with the hope of taking them up when operations start. AA Mines was also interested to participate as an implementing partner in the project, which culminated in a Memorandum of Understanding being signed with ZEPARU.

1.4 Student placement

The process of student placement was quite involving. The database of students which ZEPARU obtained from UZ, NUST and MSU was merged with the one that AA Mines already had to increase the pool and diversity of students in terms of both skills and expertise. This resulted in a total of 46 students being available for selection in the project, whose distribution was as follows (Figure 1);

Figure 1: Summary of the list of students for placements by Training Institution



Although there were students with good projects, who were ready to showcase their capacity through the engagement, some could not be accommodated into the project due to difficulties encountered in engaging the respective firms. The most affected was the food department, where targeted companies such as National Foods, Colcom, Cold Storage Company (CSC), Mukuyu Winery, Cains Foods, Afdis, Surface Wilmar and United Refineries all indicated that they could not accommodate the students on such a short period of time as it coincided with the time when the company activities were at the lowest level such that they could not get much value in the three months. The affected former students were mainly from MSU, the institution which had expressed interest in participating as an implementing partner. While other companies also expressed reservations about the short period of time, they were willing to participate in the project, mostly as a way of helping out in ensuring the project objectives are met, as they are aware that if this project succeeds, it could open up more opportunities for them in the future.

A total of 14 companies agreed to participate in the projects, with some agreeing to take as many as four interns. The names of the participating firms, their location, the sector in which they operate as well as the number of interns they were willing to take is as follows (Table 2):

Table 2: The names of participating students, firms, location and start date

	NAME	SEX	FIELD	INSTITUTION	COMPANY FOR DEPLOYMENT	COMPANY LOCATION	DATE STARTED
1	Rodney Muzoroza	M	Mechanical	UZ	Pan African Mining (Ashyire)	Banket	22-May
2	Liberty Jambaya	M	Electrical	UZ			22-May
3	Munyaradzi Madaka	M	Mechanical	UZ	Dorowa Minerals	Bhuhera	22-May
4	Chido Nyanhongo	F	Chemical	HIT			16-May
5	Albert Siziba	M	Industrial	NUST	General Beltings	Bulawayo	29-May
6	Rejoice Nyengera	M	Mechatronics	CUT			29-May
7	Cathrine Hlahla	F	Industrial	NUST			17-May
8	Delroy Muyambo	M	Mechanical	UZ			18-May
9	Felix Masendeke	M	Mechatronics	CUT	JBC		1-Jun
10	Tatenda Zvingowanisei	M	Mechatronics	CUT	BAW/ Greif Packaging	Harare, Southerton	15-May
11	Terence Chidziya	M	Production	CUT	TA Foundry Engineers	Harare, Msasa	16-May
12	Charleen Makunde	F	Chemical	USTO-Algeria	Cernol Chemicals	Harare, Willowvale	23-May
13	Rudo Mashiringwane	F	Production	CUT	Schweppes Zimbabwe	Harare, Willowvale	29-May
14	Johana Garura	F	Production	CUT	Greif Industrial Packaging	Harare, Southerton	29-May
15	Eddie Mupazi	M	Production	CUT	Clarson and Company	Harare, Workington	16-May
16	Victor Gatsi	M	Production	CUT	Schweppes Zimbabwe	Harare, Willowvale	29-May
17	Rudo Matsito	F	Production	CUT	Jacob Bethel Company	Harare, Graniteside	1-Jun
18	Tinashe Mangwiro	M	Agricultural	UZ	Clarson and Company	Harare, Workington	16-May
19	Fadzai Chatambudza	F	Agricultural	UZ	Clarson and Company	Harare, Workington	16-May
20	Perseverence Bhadhara	M	Agricultural	UZ	Precision Grinders Engineers	Harare, Southerton	15-May
21	Takunda Chiwarange	M	Mechanical	UZ	TA Foundry Engineers	Harare, Msasa	16-May
22	Alimon Shoko	M	Mechanical	UZ	JBC	Harare, Graniteside	1-Jun
23	Ruvimbo Madzimure	F	Information Technology	Catholic	Twenty Third Century Systems	Harare, Newlands	1-Jun
24	Tariro Kadzunge	F	Mechanical	UZ	Clarson and Company	Harare, Workington	17-May
25	Arnold Midzi	M	Production	CUT	Cernol Chemicals	Harare, Willowvale	23-May
26	Todd Chatema	M	Mechanical	UZ	Chemplex Corporation	Harare, Msasa	23-May
27	Tinashe Bvunzawabaya	M	Mechanical	UZ	Chemplex Corporation	Harare, Msasa	29-May
28	Tavonga Guzura	M	Chemical	HIT			29-May
29	Rutendo Bvunyenge	F	Chemical	NUST			29-May

30	Brian Munanga	M	Production	CUT	AAM Technical Training	Mashava	29-May
31	Margret Munyau	F	Production	CUT			1-Jun
32	Johnwhite Mukucha	M	Electrical	UCT-SA	AA Mines- King Mine		1-July
33	Hickman Chawasarira	M	Mechatronics	CUT			1-July
34	Louis Ndlovu	M	Chemical	HIT			29-May
35	KudzaiGunda	M	ICT	EMU-Turkey	AAMines	Zvishavane	1-Jun
36	Abner Mamvura	M	Chemical	HIT			1-Jun
37	Onisia Nyerenda	F	Chemical	HIT	AAMines/ZFC		29-May
38	Gugulethu Njobela	M	Chemical	MSU	AAMines/Sable Chemical		30-May
39	Ernest Ncube	M	GIS	MSU	MSU Mining & Mineral Processing		1-Jun
							1-Jun
40	Liberty Makacha	M	GIS				1-Jun

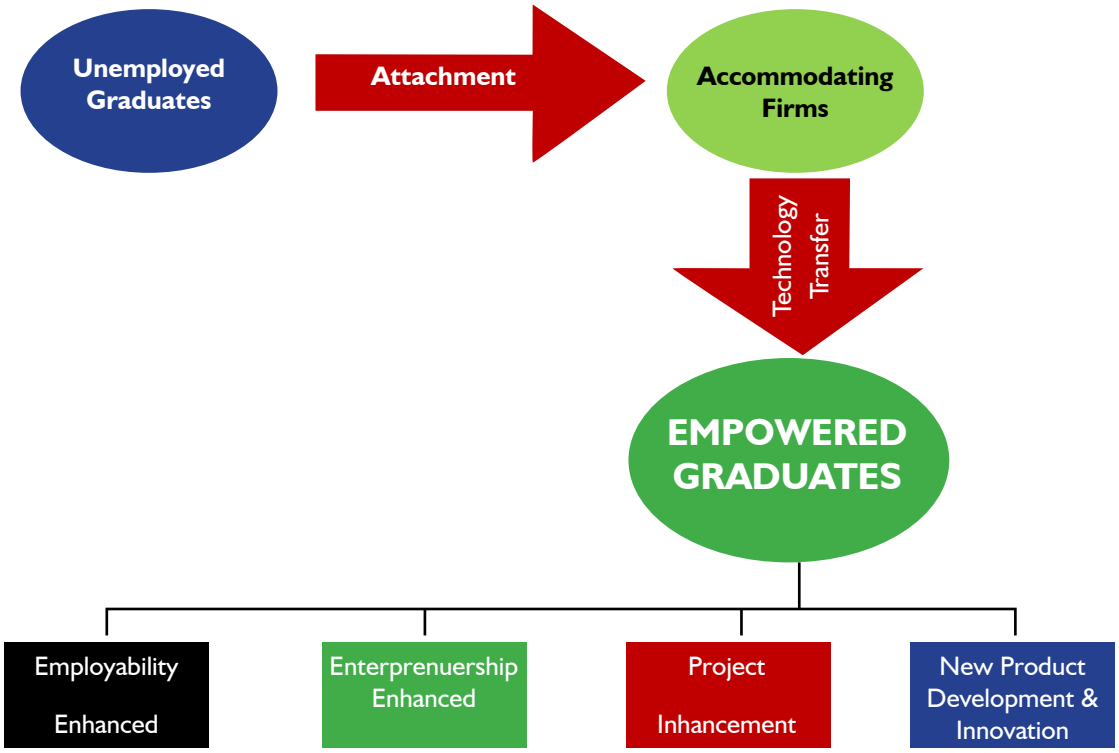
ZEPARU engaged the firms concerned regarding the project objectives and their expected roles in ensuring that the objectives are met. In the same vein, the students were also informed about their expected roles and how best they could utilize the opportunities availed to them. About 24 students participated in the initial induction exercise as a group, while the rest came individually, given that the students started at different dates as shown in Table 2.

2. POSSIBLE EXPECTED EMPOWERMENT OUTCOMES

2.1 Expected empowerment outcomes

The exposure that the interns would have under the project was expected to result in four possible outcomes, which would be critical towards the empowerment of the youths. Thus, four possible youth empowerment outcomes were expected to result from the three month internship period (Figure 2).

Figure 2: Four possible empowerment models expected following the internship



Source: Authors' construction

The four empowerment outcomes were expected to take place as follows:

i. **Employment Enhancement**

This outcome assumes that when the graduate interns are exposed, the skills innovativeness that they would have demonstrated during the three months would enhance their employment opportunities. This would arise from two possible scenarios. In the first scenario, the firms which host them would realize either a lot of cost savings based on the innovative methods that the intern would have helped put in place or realize increased revenue inflows based on some new product lines or increased production levels due to the systems that the intern would have helped establish. This would see the cost of retaining the intern in terms of their salaries being lower compared to the returns that they would have helped generate in the firms. In the second scenario, the exposure that the interns would get would make them marketable in the market and hence their chances of applying for jobs in other firms to perform related services would be enhanced. This outcome would thus be identified as a positive impact of the project.

ii. **New Product Development**

This outcome arises, where the student or the company may have a new product that they will be developing. Since companies are financially and time constrained to focus on research and new product development, the intern will be dedicated to developing the new product that will mutually benefit all parties. Relevant agreements may be signed for intellectual property protection as well as other product rights and security issues. The training institution/university may also be involved since it may have played a significant part in new product development. It may also have some of the needed facilities for product development.

iii. **Project Enhancement**

Prior to the commencement of the internship, the company may have had a project they intended to execute/ implement which would result in cost savings or increased capacity to produce output. The firm and the intern would then work out modalities for the intern to continue to pursue the project post internship. After the project has been successfully completed, the intern could either be absorbed into the firm or adequately compensated based on a predetermined method.

iv. **Entrepreneurship (Value Chain) Enhancement**

In this model, the graduate has a business idea that complements the company's operation in such a manner that there is potential for the company to subcontract the student's business to feed into their supply or value chain. Special purpose vehicles may have to be created and contracts may have to be signed by both parties. It is worth noting that the Training Institution may play an important role since some of the projects are generated by the training institution rather than the graduate himself.

2.2 Stakeholders for the models

The success of all the possible empowerment models is premised on a number of stakeholders realising that they derive some benefits from it. Such stakeholders included the following:

The hosting firms

The hosting firms were expected to take full advantage of the interns who represented additional workforce with little liability on their part. Given the current challenges that the manufacturing firms are facing, they are not in a position to recruit more labour even when the need might arise, as there are uncertainties about recovery possibilities. Firms are reluctant to absorb more labour as it would be costly to retrench when business is low. The interns thus represented an opportunity for the firms to increase their staff at no additional costs. In addition, the operating environment in the industries requires production managers to be more concerned about meeting targets, leaving them with little time to concentrate on productivity enhancement and innovative methods of reducing costs. Thus, the availability of the interns, who were fresh with untested ideas, offered an opportunity for the firms to delegate the innovative production systems to them. The interns were expected to identify current challenges and think of possible solutions to the problems which would save time and costs to the firms. The firms were thus expected to realise the opportunities that the project was bringing and utilise them.

The interns

The success of the project hinged on the ability of the interns to live up to expectations at the firms. The interns were expected to demonstrate their worth to the firms such that at the end of the internship period, the firms would maintain relations with them. In such cases the interns would have demonstrated commitment to the work, discipline, identified some problems which the firm would need to solve to increase productivity or reduce costs and also shown a general appreciation of the business and its vision.

Given that the internship period was only three months, it was also not expected that the firms would have implemented all the projects which the interns would have identified as critical for enhancing production and productivity. However, there were two types of projects that would have been identified; those whose implementation would require very little to no capital injection to implement and those that would call for significant investment. It was expected that at the end of the three months, at least those projects calling for little to no capital injection would have been tried and the firms would now be happy to retain the interns to pursue other more costly projects which the interns would have identified but calling for more time and resources. Under such scenario, the intern would either be absorbed into a full internship programme or as an employee, based on the fact that the amount of savings that the identified projects would bring to the firm would be far larger than the salary or allowances that the interns would be paid upon retention.

In the event that the intern would have demonstrated that a project whose implementation would go beyond the three months is worth taking, it was also expected that the firm would want to keep the intern to see through the project. Again this would be achieved by either a full internship programme or an extended period where the intern would only come to pursue the project together with the firm on a voluntary basis, on the agreement that if the project succeeds and result in significant savings, the intern would be employed in the firm.

Where the identified projects would result in new products being developed with possibilities of being marketed elsewhere, it was also expected that the firm might have an arrangement with the interns to allow them to continue to develop the products. However, when completed the firm and the intern would work out arrangements on sharing the proceeds from the sale of the products based on how the intellectual property rights agreements to the products would be worked out between the two parties. The onus was therefore on the intern to demonstrate that it is possible to develop such products which would improve the product portfolio of the firm as well as enhance revenue.

Training institution/University

The training institutions and universities were considered key partners for the success of the project. In addition to identifying the students with potential who had passed through the institutions, it was also appreciated that some of the projects which the interns would try to put in place in the firms would have originated as part of the projects that the students are expected to complete during their final year at the tertiary institutions. The lecturers therefore might have played a significant role in the design of the project as well as in helping to ensure that the idea comes to fruition. In that case, the tertiary institutions could also have an interest in ensuring that the projects succeed. In the event that the interns would want to pursue the entrepreneurship route, it might be necessary to partner, on a commercial basis, the tertiary institutions who also contributed in implementing the project.

One tertiary institution, the Midlands State University (MSU) also expressed interest in being part of any similar project in future for the interns who would want to pursue the entrepreneurship route. In that case after the student has finished the placement and has sharpened the skills, the university could come in as a partner in facilitating the commercialization of the project. For example, the student, being the manufacturer can run the project but MSU would assist in sourcing the initial equipment or availing the facilities for the student to operate in. MSU would have a facility which has an incubator where all products can be produced and marketed rather than relying on firms for placements. For example, a canning facility can be at the place, where the products developed by the interns can be canned and marketed.

Financial institutions

Entrepreneurship would require start-up capital, which neither the interns nor their guardians would be expected to afford. The financial institutions were thus considered central to the success of the entrepreneurship route. The expectation was that financial institutions would develop an interest in promising and viable projects being undertaken by the interns and avail seed funding for such projects. These would be mostly those projects where products could be developed at a low cost which would make it easy to secure funding at terms which could suit the interns. Financial institutions and the interns would be expected to work out the possible methods of securing the funding.

Projects that would result in new products, even at firm level, could also require the services of the financial institutions, especially where the partnering firms have funding challenges but are sure that the new products developed have a ready market and are profitable. Under such a scenario, the firm would approach its bank for funding to ensure that the necessary investment to operationalise the project idea which the intern would have suggested is in place. Financial institutions were thus considered critical for the success of the pilot project.

The major stakeholders for the models and their expected roles are summarised in Table 3.

Table 3: Major stakeholders and their expected roles

KEY STAKEHOLDER	MAJOR ACTORS (EXAMPLES)	EXPECTED ROLES OF STAKEHOLDERS FOR EACH MODEL			
		EMPLOYABILITY	NEW PRODUCT DEVELOPMENT	PROJECT ENHANCEMENT	ENTREPRENEURSHIP
The Graduate	Diplomas, BScs,MScs, PhDs	Exposure & Skills development	Exposure, Innovative ideas	Exposure, Project idea, Implementation	Exposure, Skills development, Innovative business Idea (s)
The Company	Mining, Chemical, Engineering, Iron & Steel, Telecoms, Energy, Agro; Food, Environment, ITC, Parastatals, etc	Internships, Specialised Training, Skills development, Employment	Infrastructure & resources, Specialised Training, Innovative ideas, funding	Skills development, project idea, infrastructure & resources, funding, implementation	Skills development, business Idea (s), infrastructure & resources, funding, market (subcontracting)
The Training Institute	UZ,NUST,CUT,MSU, Catholic, BUSE, SIRDC, etc	Relevant training; Collaboration with industry, Specialised training	Collaboration with industry, Innovative ideas, Research & Development, Patenting & IP	Graduate Mentorship, Specialised training, Collaboration with industry	Training, Collaboration with industry, Developing and nurturing innovative project ideas
Regulatory bodies	ECZ, ZIE, ZACE,ZERA, EMA,REA, SAZ	Mentorship, Specialised Training, Accreditation & Licensing, Promotion, Funding	Collaboration with industry, Promotion & Advocacy, Licensing & Permits, Funding, Patenting & IP	Mentorship, Licensing, Specialised Training, Funding	Mentorship, Licensing, Specialised training, prospective funding to pilot test innovative ideas related to their mandates.
Representative bodies	EISAZ, CZI, CoM, SMEAZ	Linkages with industry, Funding, Specialised Training	Resource mobilisation, Promotion & Advocacy, market linkages	Resource mobilisation, Promotion & advocacy	Provision of industry specific technical training and advice; Resource Mobilisation and Market linkages.
Developmental Partners	Practical Action, GIZ, SNV, UNIDO, EU, USAID, etc	Resource mobilisation, Specialised Training	Resource mobilisation, Promotion & Advocacy, market linkages	Resource mobilisation, Promotion & advocacy	Prospective partners in scaling up pilot project; ResourceMobilisation, Market linkages, Specialised Training.
The Financial Institutions	AfDB, RBZ, BAZ, ZAMFI, IFC, IDBZ	Resource mobilisation	Funding facilities & grants	Funding facilities & grants	Funding facilities & grants
Government	MoSMEs, MoIC, MoEPD, MoYE, MoHTESTD,etc	Policy, Funding	Funding facilities & grants	Policy, Funding facilities & grants	Policy, funding facilities & grants

3. OVERVIEW OF INTERNSHIP INDUSTRIES

3.1 Firms involved and products

The pilot project involved 14 firms in 7 main subsectors namely mining, manufacturing, foundries, original equipment and components manufacturing, chemical manufacturing, consulting services and information technology, as shown in Figure 3.

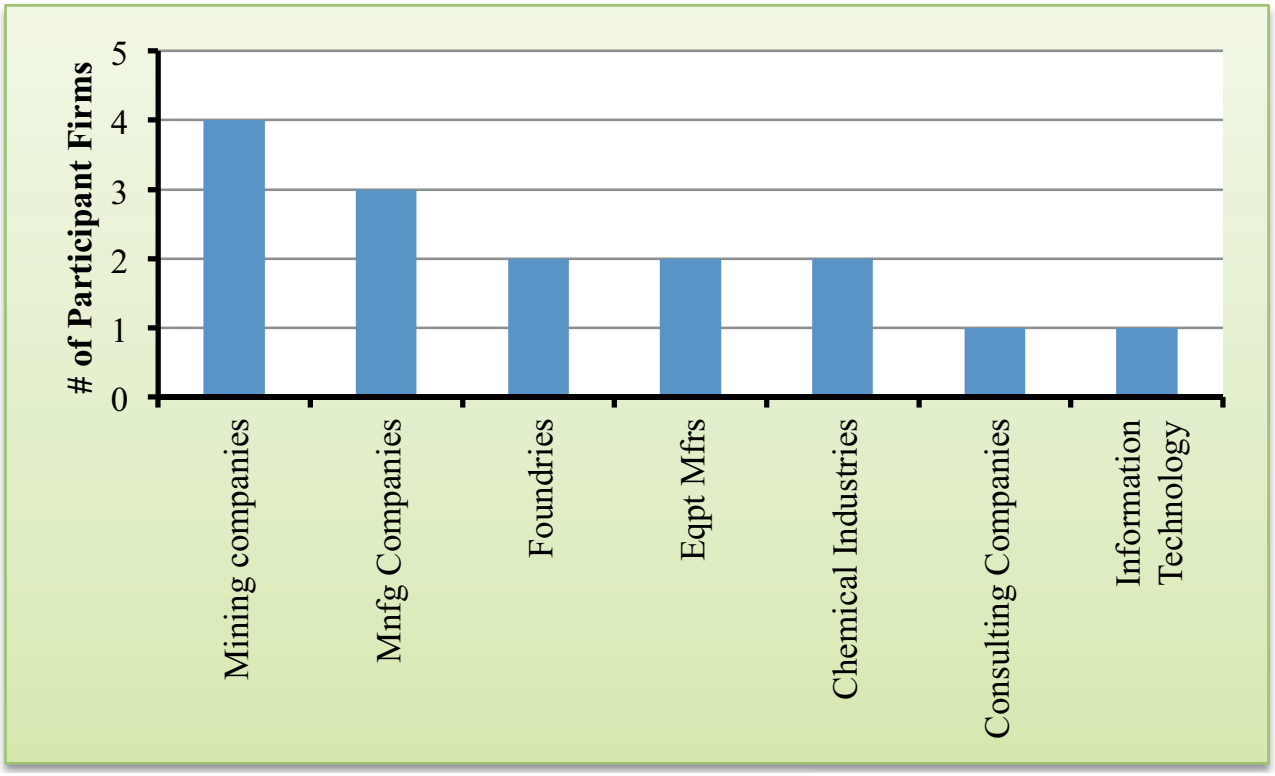


Figure 3: Sectoral representation of firms

The participating firms were as follows;

- Mining Companies *(Asbestos, Chrome, Gold and Limestone)*
- African Associated Mines (Mashava Mines, Shabanie Mines)
- Pan African Mines (Ayrshire Mine in Banket)
- Dorowa Minerals
- Manufacturing *(conveyor belts, packaging & beverages)*
- General Beltings (Bulawayo)
- Greif Packaging (Harare)
- Schweppes (Beverages production – Harare)
- Foundries (mining, agriculture & general engineering components)
- Clarson & Company
- T&A Foundries
- Original Equipment Manufacturers (mining & agricultural equipment)
- Jacob Bethel Corporation (Harare & Bulawayo)

- Precision Grinders Engineers (Harare)
- Chemical Industries
- Cernol Chemicals (Harare)
- Zimphos (Harare)
- Consulting Firms
- Midlands State University (Zvishavane Campus - Geology Department)
- Information Technology
- Twenty Third Century Systems Solutions

3.2 General industry overview for the firms

The participating firms can be grouped into five sectors; (i) the Engineering, Iron and Steel; (ii) mining and mining processing; (iii) chemical; (iv) beverages and (v) information communication technology. Each of these industries has its own challenges and solutions which the interns, in their capacities as production, mechatronics, electrical, chemical and industrial engineers as well as geographic information system and ICT experts would be able to identify and proffer possible solutions. Briefly, the following are some of the key challenges that these industries are facing:

Engineering, Iron and Steel Industry

This sector plays a central role in ensuring overall manufacturing sector competitiveness, given that it is a critical supplier of equipment and industrial parts used in the manufacturing sector. The sector is currently operating sub-optimally as reflected by a number of indicators. The 2015 National Employment Council (NEC) report for the sector identifies the following as the key challenges affecting the sector:

- declining sales;
- cash flow constraints;
- high cost of production;
- space (land) challenges; and
- lack of skilled and experienced manpower.

Due to these challenges, about 69.2% of the firms in the sector are now operating at capacity utilisation levels of below 50% (NEC, 2015). As a result retrenchments, failure to sustain minimum wage payments and salary/wage arrears characterise most of the firms operating in the sector.

These challenges, combined with the use of old equipment as well as old ways of doing things provided the scope for the interns. The interns were thus expected to be instrumental in identifying methods of reducing production costs, increasing sales as well as removing manual systems which were labour intensive to contain labour costs.

Mining and mining processing industry

The Zimbabwe minerals sector is a major foreign currency earner and has potential to become the pillar for economic growth and development through value addition and beneficiation. Despite its potential, the industry's current contribution to economic growth is still well below expected targets, downplaying its role

in export earning, employment creation and poverty reduction. Among the challenges faced by the minerals industry are lack of human capital and tools of trade as well as policy and support infrastructure which are either inadequate or poor or both.

In addition, the mining processes are also characterised by less cost effective production methods, mostly due to limited research and development. Thus, there is limited uptake of new innovative ideas into the production systems, which also affects growth potential. The interns were thus expected to identify such opportunities and contribute positively to the growth of the mining firms which they were attached to.

Some interns were also placed in mining establishments which are currently not operational. These mines are more focused on resuscitating their production lines based on old methods. The interns were also better placed to identify some of the currently underutilised products which can also be used as income streams by the closed mining houses.

Beverages

The beverages sector can be considered as one of the few sectors that are doing relatively well compared to other sectors. However, there is still scope for more to be done to enhance production, especially in the face of import competition. There are a number of challenges which also affect production, on which the interns were also expected to help solve. The operations in the beverages sector depend on the performance of the agriculture sector, which has been performing poorly over the years. Thus, challenges such as insufficient raw materials, low demand, working capital constraints, power and water shortages and antiquated machinery and breakdowns currently affect capacity utilisation (ZEPARU, 2014). The sector is also characterised by use of non-renewable energy sources which are not available, with limited use of alternative sources of energy such as solar or gas.

Two interns were placed in a beverages firm. The expectations were that they would be able to understand the operations and identify possible changes that could be made to enhance productivity.

Chemical Industry

The Zimbabwean chemical sector, which is comprised of about five categories, namely: Chemical Raw Materials, Chemical Refineries / Processors, Speciality Chemicals, Consumer Care Products and the "Other Industrial Chemicals" sub-sectors, is the fourth-largest employer in manufacturing, behind food products; mining; engineering & metals; and clothing, textiles & apparel (ZEPARU 2014b). The development of the chemicals sector is necessary for the promotion of the beneficiation of minerals into primary products for exports as well as to provide the necessary feedstock into the manufacturing sector in general. Other downstream sectors such as polymers, ceramics and chemical formulations also depend on the chemicals sector.

The chemicals industry faces a number of challenges which are worsened by limited availability of natural petroleum resources, resulting in most of the necessary chemicals (e.g. caustic soda, ammonium phosphate, ammonium nitrate, magnesium sulphate) being imported. Some of these challenges among others are:

- Out-dated technology;
- Shortage of working capital and absence of lines of credit;
- Highly inadequate and erratic supply of key economic enablers namely electricity, fuel, coal and water;
- Unfair competition from imported products;
- Prohibitive import duty for raw materials;
- Dilapidated infrastructure;
- De-industrialisation and the widespread closure of companies;

- Non-payment for consignments;
- Policy inconsistencies, especially with respect to economic empowerment and indigenisation regulations;
- Adverse global economic developments;
- Difficult external sector position; and
- Persistently recurrent liquidity challenges (ZEPARU, 2014b).

The interns were therefore placed in the industry with the expectations that they would also identify other possible operation methods and innovations which would be needed to help mitigate the impact of these challenges.

4. SKILLS AND COMPETENCIES OF THE INTERNS

The pilot program involved a total of 40 unemployed interns in different engineering and technology disciplines as shown in Figure 4 below.

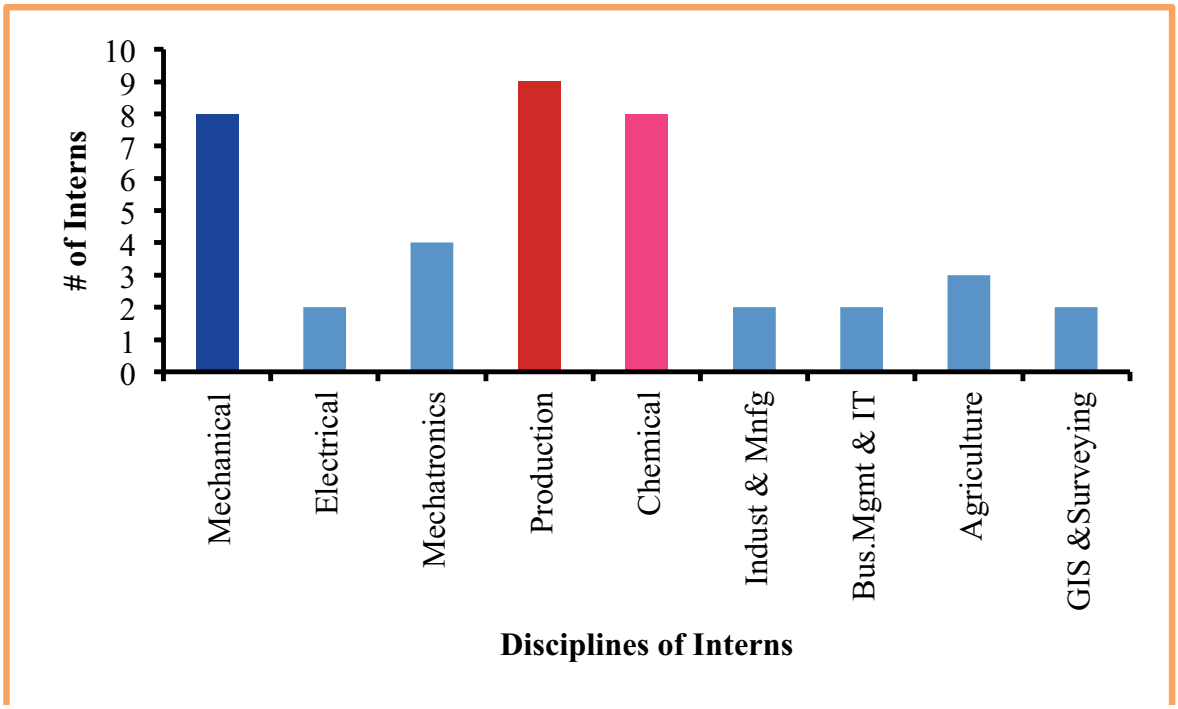


Figure 4: Disciplines of participating interns

As presented in Figure 4above, 40 interns who participated in the pilot program were drawn from 9 disciplines namely mechanical, electrical, mechatronics, production, chemical, industrial and manufacturing and agricultural engineering; geo-informatics systems and surveying and business management and information technology. There was relatively a high number of interns from the production, chemical and mechanical engineering disciplines. The high number of production engineering interns was attributable to the fact that they are produced in high numbers and compete for jobs with industrial and manufacturing interns within the dwindling manufacturing sector. The high number of chemical engineering students was also attributable to the high number of graduates being produced by NUST, HIT and MSU within a dwindling and constrained chemical industries sector with a few players. The high number of mechanical engineering interns was attributable to the fact that the University of Zimbabwe, Mechanical Engineering Department had a readily available database of graduated interns, enhancing placement at firms.

The years the participating interns graduated are presented in Figure 5 below.

Figure 5: Year of graduation for the participating interns

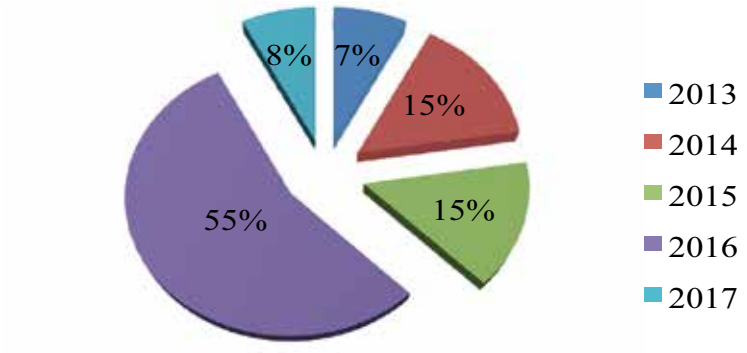
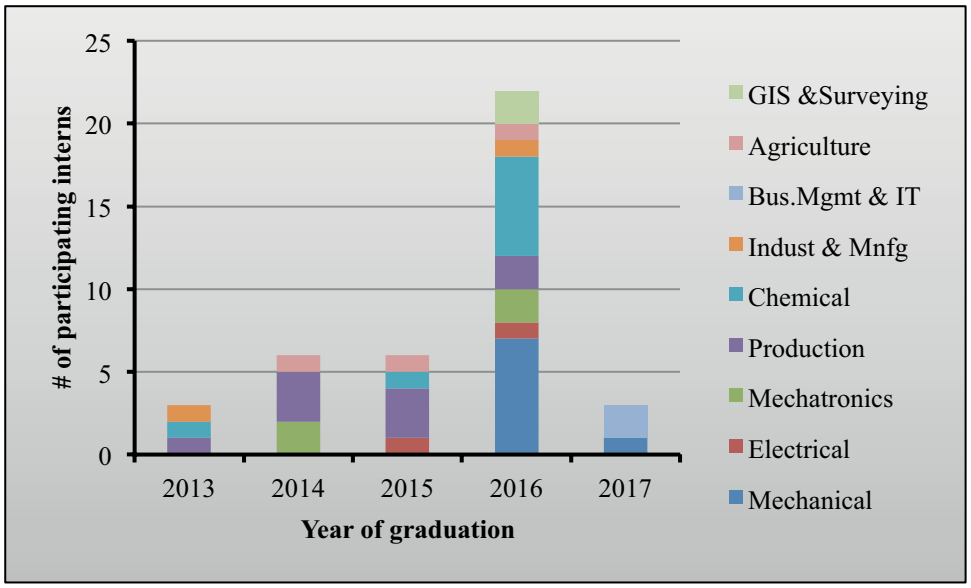


Figure 5shows that 55% of the participating interns graduated in 2016 whilst 37% graduated in 2015 and before. It is worth noting that the higher percentage of 2016 graduates is due to the fact that they were far much easier to access in the pilot program than those who finished years earlier since most training institutions did not have readily available databases and linkages with their former students. Nevertheless, the significantly high number of unemployed graduates who graduated in 2015 or earlier shows the serious unemployment crisis and intellectual waste which must be addressed through youth empowerment. Figure 6 below shows the year of graduation by discipline.

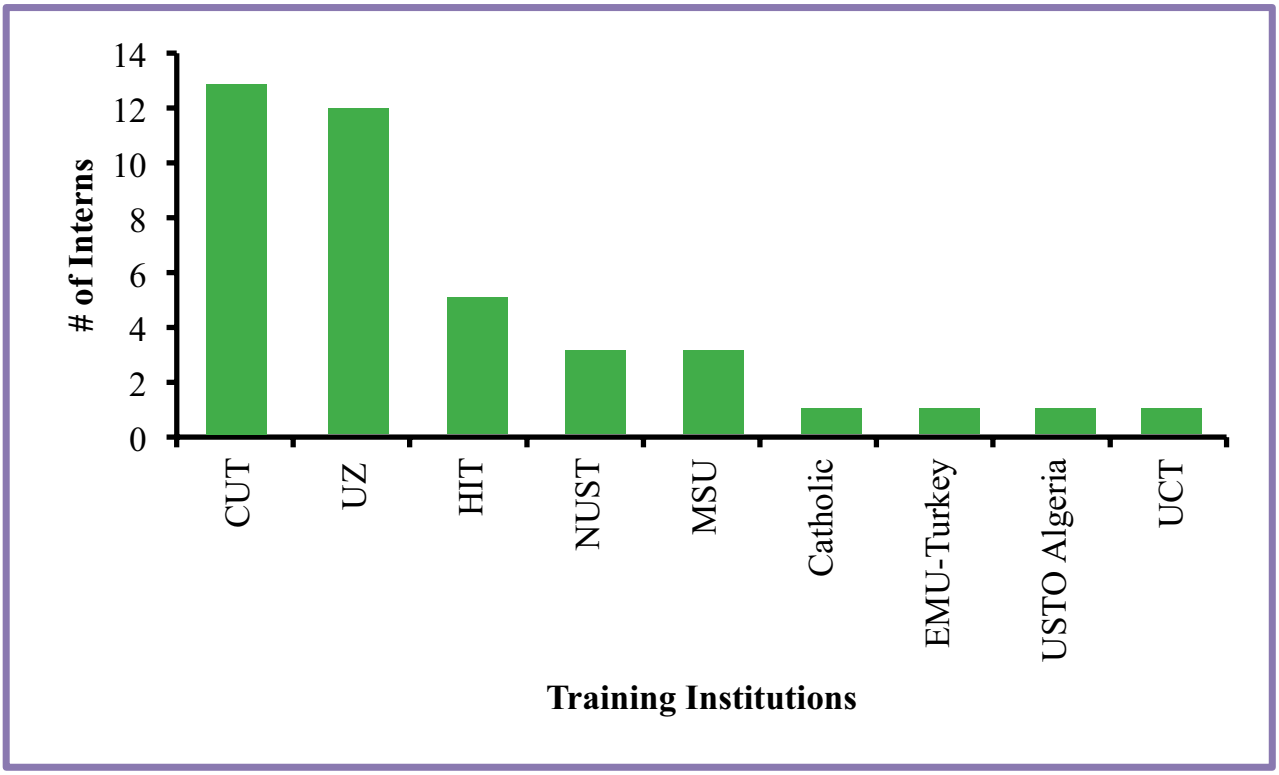
Figure 6: Year of graduation by discipline



Indicatively, Figure 6, shows that the production, mechatronics and chemical engineering disciplines may be the most affected as far as employment is concerned. For production engineering, this could be attributable to two main factors namely i) high yearly production rate of graduates from competing training institutions (HIT, NUST and CUT – Industrial & Manufacturing Engineering); and ii) since CUT is relatively the younger of the competing institutions, the employing companies may have limited knowledge of the institution. For mechatronics, the discipline is relatively new to most Zimbabwean industries and hence firms might have bias towards conventional disciplines yet ironically, this discipline is very relevant and is much synchronised to new technologies that are less labour intensive, mechanised and automated. As for chemical engineering, the conventional industry is constrained since it was mainly dominated by companies like Zimphos, Cernol, etc which are currently struggling, thus offering limited employment opportunities.

The participating graduates by training institutions are presented in Figure 7 below

Figure 7: Participating interns by their training Institutions



CUT and UZ provided the highest number of participating graduates, whilst HIT, NUST and MSU provided relatively fewer interns. This was due to a variety of reasons. The University of Zimbabwe had a readily available database of their 2016 graduates which made placement easy. HIT's database was not ready available and their protocols were relatively longer, same applies to NUST. Whilst MSU was willing, the companies that could potentially take their interns could not do so citing the short duration of the pilot program as a handicap.

5. IMPACT OF THE INTERNSHIP TO DATE

The program generally had positive impact on both the graduates and the firms. The positive impacts go beyond the two mentioned parties and extend to the training institutions, other key stakeholders and ultimately the nation's political and socio-economic development.

5.1 Impact on the interns

5.1.1 Employability enhancement

After merely 3months, 6 (15%) of the graduates were offered employment opportunities after showing exceptional potential. One was given a junior management position whilst the rest were offered full internship programs at the companies of placement. The sectors that have absorbed these interns are foundries, original equipment manufacturing and the mining industry. Ironically, three of the 6 interns completed their production, agricultural and mechatronics engineering degrees in 2014. It proves that there are many graduates with great potential to turn around the industry who are seated at home. Additionally, 2 firms (manufacturing & chemicals) are considering taking their 3 attached interns and were still weighing their options. If they reach their conclusions, then those employed from the pilot program will rise to 22.5%. It would be worth noting that all the 3 interns graduated in or before 2015, and 2 of them being production and mechatronics graduates.

Although the tenure of the pilot program was too short by industry standards, the graduates gained valuable exposure from the companies as summarised in Table 4 below and hence boosting their confidence and their practical experience and exposure, thus making them better positioned for employment opportunities.

Table 4: Summary of key experiences gained by the interns

	Company Name	Technology transfer to intern
1	Cernol Chemicals	Water Treatment; Chemicals Production
2	Clarson and Company	Foundry technology, Production management
3	Greif Industrial Packaging	Plastic & Flexible Packaging, Production Management
4	Jacob Bethel Company Harare	CNCs, Production management
5	Precision Grinders Engineers	Design & Fabrication of Agricultural Equipment, Production management
6	Schweppes Zimbabwe	Production management, Quality Management Systems, Maintenance Management Systems, beverage processing, water treatment
7	TA Foundry Engineers	Foundry technology, machine shop engineering
8	Twenty Third Century Systems	Helpdesk system, hardware, software engineering, Inventory management
9	Zimphos	Chemicals production, water treatment, Boilers
10	AAMines – Mashava	Hoist maintenance, mine shutdown maintenance
11	AAMines – Zvishavane	Minerals processing, mine shutdown maintenance, water treatment
12	Midlands State University – GIS	GIS Technology application
13	General Beltings	Production engineering, instrumentation & control
14	Jacob Bethel Corporation	Mining equipment design, manufacturing and repairs & maintenance
15	Pan African Mining – Banket	Mine Shutdown Maintenance, Hoist maintenance
16	Dorowa Minerals	Minerals processing, & maintenance

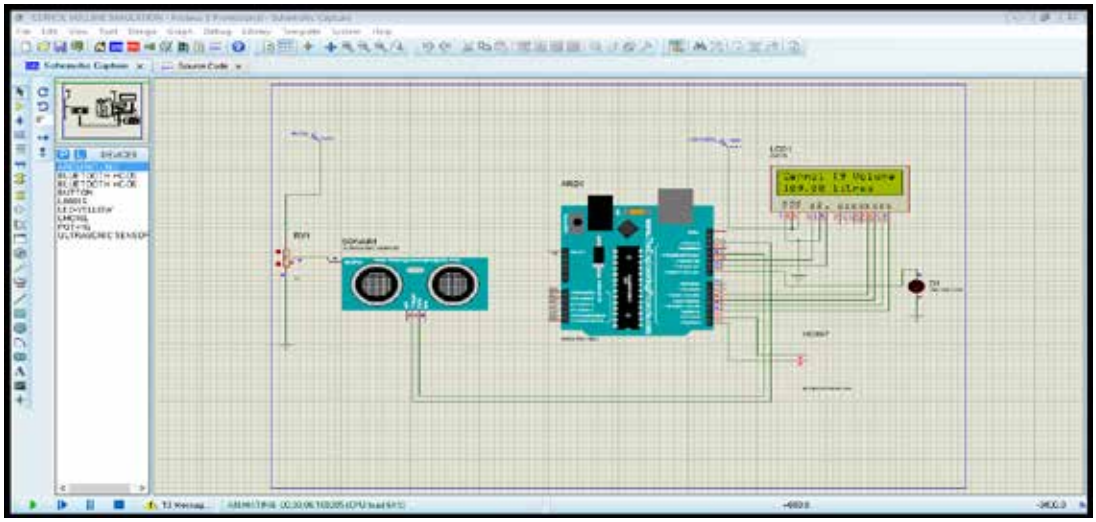
5.1.2 New Product Development

Although the pilot program was too short for significant new product development, some interns were able to develop, initiate or contribute significantly towards innovation in production or new product development.

Product 1: Intelligent Bulk Quantification System: Arnold Midzi (Production Engineering, CUT, 2015); Cernol Chemicals

One of the innovative products is an automatic and ICT integrated bulk quantification system for measuring volumes of liquids for industrial and commercial applications. With the support of Cernol Management, the components for assembly were purchased and implementation is in progress. The product has great potential on the market finding application in the petrochemical industry (service stations, chemical industries); food processing and municipal water works amongst others. The same intern also implemented an IT based inventory management system for chemicals procedures. The simulation of the intelligent bulk quantification system is presented in Figure 8 below.

Figure 8: Intelligent bulk quantification system simulation model for Cernol



Product 2: Automated conveyor idler (roller) manufacturing line: Felix Masendeke (Mechatronics, CUT, 2014); Jacob Bethel Corporation, Bulawayo

Felix Masendeke initiated significant innovative ideas approved and being implemented at JBC Bulawayo which are i) 32mm collet drafting and production; ii) centering tool, iii) sand blasting system and iv) automated conveyor idler (roller) manufacturing line. The centre finding tool for hollow jobs on boring mill, lathe, milling machines reduces the set up time by 75%, translating to about 37.5% of a working shift. The sand blasting system will eliminate the outsourcing of sandblasting services for the company, saving the company money and reducing lead times with a payback of 3months. The major project, which is the automation of the conveyor idler (roller) manufacturing line, will increase production capacity from the current 130 rollers/day to 300/day resulting in reduction of lead times by 23%, and labour reduction by 15% with a payback period of less than a week. The collet drafted manufactured by the intern is presented in Figure 9 below;

Figure 9: Collet drafted and CNC manufactured by the intern at JBC

Product 3: Die Cavity for localised forging of hexagonal rods into cylindrical heads: Alimon Shoko (Mechanical Engineering, UZ, 2017); Jacob Bethel Corporation, Harare

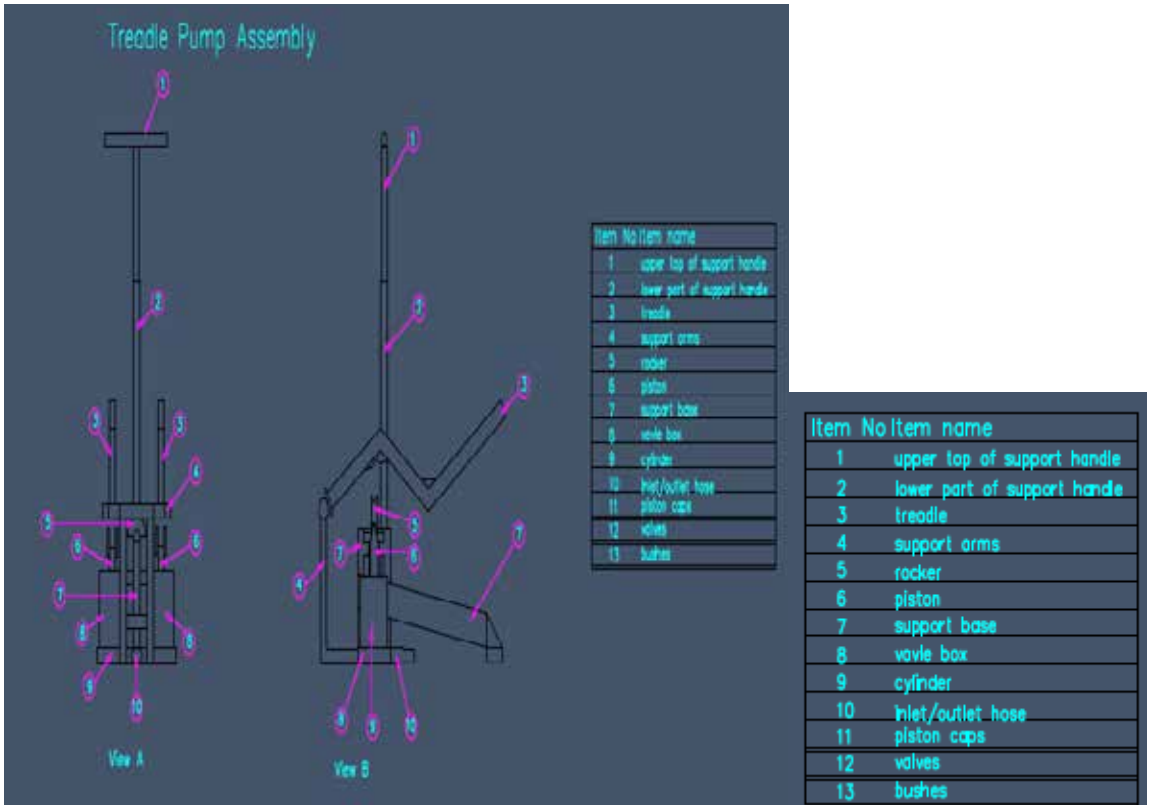
Alimon Shoko at JBC Harare designed a die cavity for the localised forging of 24mm hexagonal rods into 32mm cylindrical heads. The tool has great impact in reducing the lead times to production as well as safety of operation. The material handling device is presented in Figure 10 below.

Figure 10: Existing product handling device vs the proposed Die Cavity device (3D model)

Product 4: Treadle Pump for low income small holder irrigation: Margaret Munyau (Production Engineering, CUT, 2013); AA Mines Technical Training Institute, Mashava

The treadle pump has potential use for irrigation of small holder plots and gardens in low income remote areas far from the grid. This product was proposed by Margaret Munyau, a production engineering graduate from CUT, who graduated in 2013, and placed at AAMines Technical Training Institute at Mashava. The treadle pump conceptual drawings are presented in Figure 11 below and prototype development is work in progress.

Figure 11: Treadle pump conceptual drawings

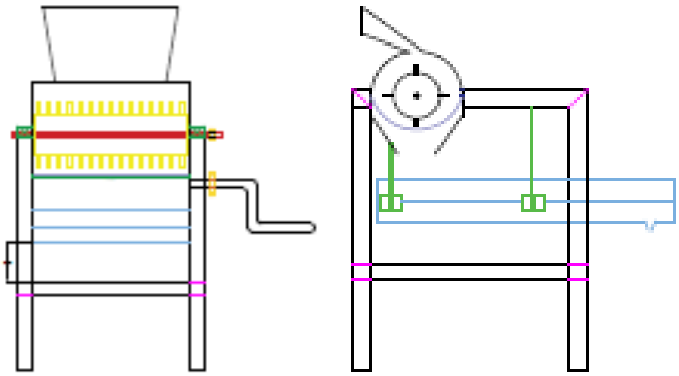


In one region (Nyanga district), similar imported ones from Kenya were selling at USD170.00/pump, and annual sales were at about 144 (USD24,480/yr), Considering about 59 districts, in Zimbabwe, potential sales volumes of about 8500/yr and annual revenues of about USD1.4 million are feasible.

Product 5: Design of manually operated small grain thresher to reduce post-harvest losses and increase productivity: Perseverance Bhadhara (Production Engineering, CUT, 2013); Precision Grinders Engineers, Harare

Perseverance Bhadhara, an Agricultural Engineering graduate (CUT, 2014), designed a "manually operated small grain thresher to reduce post-harvest losses". The product is targeted for the dry regions of the country which include Matabeleland, Masvingo and the low rainfall regions. According to a research done by ZEPARU, small grains production ranges between 200, 000 and 500,000 tonnes per year, the majority of which is threshed manually. The semi-mechanised thresher will therefore enhance post-harvest processing, increase productivity and minimise losses. The cost of each unit is about USD1000.00. There is potential to sell over 5,000 units implying potential revenues of over USD5,000,000.00. The manual thresher conceptual drawings are presented in Figure 12 below.

Figure 12: Manual small grains thresher conceptual drawing



The company, Precision Grinders Engineers and the intern are still working on modalities of taking the project further starting with the prototype, optimisation, scaling up and project roll out.

5.1.3 Project Enhancement

Several projects were initiated by the interns under the pilot program.

Project 1: Commercial production of natural fertiliser and biogas from sewage for Zvishavane Town Council: Gugulethu Njobela (Chemical Engineering, MSU, 2015); AAMines, Zvishavane

Of note was the project on the "Commercial production of natural fertiliser and biogas from sewage for Zvishavane Town Council" proposed by Gugulethu Njobela with the help of AAMines Shabanie. The intervention is an anaerobic digester which treats the sewage, with the sludge output becoming natural fertiliser. The total sewage produced in Zvishavane in 2016 was 1,736,230 m^3, with 641, 230 being disposed of, untreated. Thus, the sewage has a potential of producing 58,375,910m^3 of biogas per annum, translating to 233,504MWh/annum (USD28Million/Annum). A 3m^3 prototype was constructed at AAMines Civil and Amenities Department in Zvishavane and is under testing and optimisation. The results if positive will result in scaling up to commercial scale, thus providing a complete home-grown solutions for water, sanitation, hygiene and energy nexus for the country. The prototype under testing and optimisation is presented in Figure 13below.

Figure 13: Prototype anaerobic digester and natural fertiliser producing reactor

Project 2: Chromite Ore Fines beneficiation at AAMines Mashava: Hickman Chawasarira (Mechatronics, CUT, 2016); AAMines, Mashava

The project involved design and fabrication of a chrome ore fines screening line to improve productivity and recovery whilst using minimal amount of water. The project is expected to produce 1000tonnes/month at an approximate recovery rate of 30%, with a duration of 1 month and generating revenues of over USD500,000.00/annum. When complete, the project may be applicable to small scale chrome artisanal miners dotted around the country. The prototype development is work in progress.

Other Projects

The graduates were also exposed to various projects with potential positive impacts to the companies and were tasked with either implementation or coming up with problem solving initiatives. Over 18 projects were identified and at different stages of implementation. The projects are summarised in Table 5 below;

Table 5: Projects involving the interns

	PROJECT NAME	DURATION (MONTHS)	APPROXIMATE VALUE/ BENEFIT (USD)	STATUS	GRADUATE NAME	COMPANY
1	Development of an appropriate CMMS for Zimphos	6	10,000.00	WIP	T Bvunzawabaya	Zimphos
2	Design of a lubricant recirculation system for BP Mills at Zimphos	3	5,000.00	WIP	T Bvunzawabaya	Zimphos
3	Design of Vacuum Concentrator for Alum Concentration at Zimphos	2	Not Known	WIP	T Guzura	Zimphos
4	Boiler efficiency improvement through preheating of feedwater using Alum Plant condensate water at Zimphos	5	Not Known	WIP	R Bvunyenge	Zimphos
5	Resuscitation of CompAirSet900 dryer at Greif Packaging	1	Not Known	Completed	T Zvingowanisei	Greif Packaging
6	Redesign and wiring of a cost effective control system for Guillotine to improve productivity and safety	1	Not Known	Completed	T Zvingowanisei	Greif Packaging

7	Redesign and wiring of a cost effective control system for SDS Drumlines for productivity improvement at Greif Packaging	1	Not Known	Completed	T Zvingowanisei	Greif Packaging
8	Plant Energy Audit and Energy Management System for Greif Packaging	3	Not Known	WIP	T Zvingowanisei& J Garura	Greif Packaging
9	Design & Fabrication of an animal traction boom sprayer for small holder farmers	4	>24,000/yr savings	Design Completed	T Chiwarange	T&A Foundry
10	Implementation of a UPS Notification System	2	Not known	Completed	R Madzimure	Twenty Third Century Systems
11	Boiler Optimisation and Control System for Schweppes	3	>30,000/yr savings	Design Completed	E Mashiringwane & V Gatsi	Schweppes
12	Lean Implementation Program for Clarson Foundry	6	>20% savings/yr	WIP	E Mupazi	Clarson& Co
13	Production Work Model development for General Beltings	2	20 - 45% reduction in lead times	Completed	A Siziba& C Hlahla	General Beltings
14	Boiler System Optimisation and Energy Efficiency improvement for General Beltings	3	>15% energy savings	WIP	D Muyambo	General Beltings
15	Characterisation of portable water for Zvishavane Town Council to improve water quality and health	3	Not Known	WIP	O Nyerenda	AAMines, Shabanie
16	Recovery of shingles B fibre from the dump at Shabanie mine dumps	12	>150,000/yr revenues	WIP	A Mamvura	AAMines, Shabanie
17	Hospital Management System for Shabanie Mine Hospital	6	Not Known	WIP	K Gunda	AAMines, Shabanie
18	Development of an Internal Geological Spatial Data Information Management System for MSU Zvishavane Campus	6	Not Known	WIP	L Makacha& E Ncube	MSU, GIS Department

5.2 Impact on the firms

The impact on the firms was as follows;

i) Productivity improvement initiatives through proposals initiated by the interns. These initiatives include repairs, maintenance and resuscitation of broken down lines, improved material handling systems and new product development initiatives

ii) The firms realised that the technology transfer to interns will help cover the looming skills gap in 5 to 10 years considering the continuously advancing technologies and the brain drain to South Africa and high income countries

iii) Firms also appreciated the great potential in the interns as a resource base for the skills they need for the current and future as well as for subcontracting.

iv) The pilot program also helped create linkages between training institutions, the interns and the firms to jointly solve common industrial problems in a more practical and effective manner

The projects jointly initiated by interns and firms like the Anaerobic Digester and Natural Fertiliser production will help in reducing Water, Sanitation and Hygiene problems whilst simultaneously addressing food and energy security through enhanced agriculture from natural fertiliser and energy from biogas.

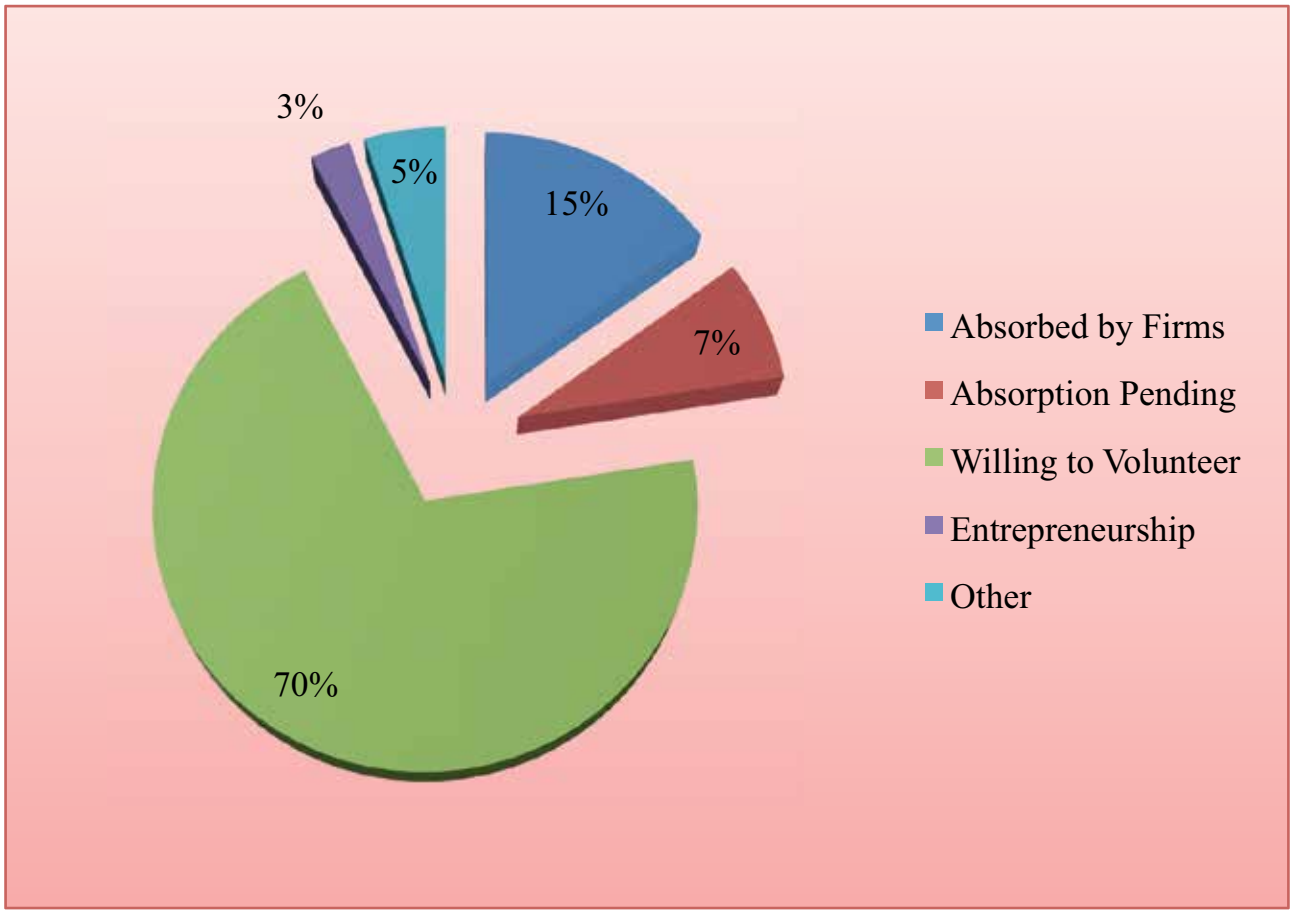
Empowered graduates will also reduce unemployment through entrepreneurship and new employment models through the joint efforts of all stakeholders. Such empowerment initiatives will go a long way in implementing import substitution strategies and policies in the engineering and manufacturing sectors of the country. Ultimately the economy will improve with the consequential benefits to the nation and livelihoods.

6. FUTURE EXPECTATIONS ON EMPOWERMENT

6.1 Current status of the interns

The current status of the interns after the pilot program is presented in Figure 14 below

Figure 14: Status of the interns after the pilot program



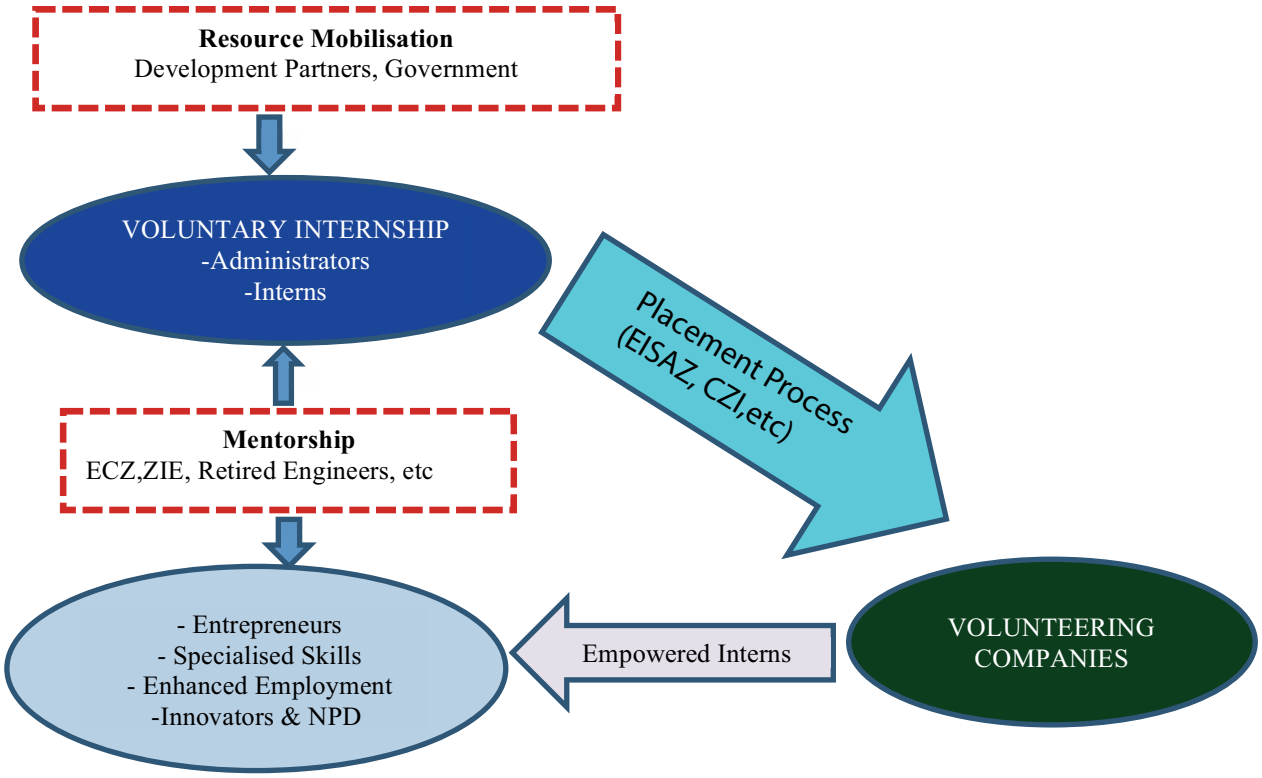
After the three months pilot program, about 70% of the interns are willing to volunteer for at least 6 months to fully maximise on technology transfer since the tenure of the pilot program was too short. Six firms indicated their willingness to accommodate the volunteering interns since they also noted the tenure of the pilot program to be too short considering that typical internship program last between 6 to 24months. About six of the interns were absorbed by the companies at which they were attached, whilst decisions for absorption are still pending for 3 of the interns and are on voluntary pending the ultimate decision on them. Only one intern (3%) is pursuing entrepreneurship after the pilot program. It was also noted that entrepreneurship is not easy for technically minded people despite the fact that they are taught entrepreneurship at school. The mindset, the operating environment, access to financing and limited entrepreneurship skills are all major handicaps. It was also noted that entrepreneurship is not easy even for the seasoned firms and professionals, thus it requires a holistic approach involving the intern, the mentors, the firms and other relevant stakeholders.

6.2 Possibilities for pursuing the different models

6.3 Voluntary program

Considering the overwhelming willingness to volunteer inorder to complete outstanding projects as well as to gain more exposure and maximise technology transfer, a Voluntary Program is proposed. The modalities for such a voluntary program should be worked out considering emerging issues like liability in case of accidents, intellectual protection, administrative costs associated with the voluntary programs, etc. Figure 15 presents framework for model development for the Voluntary Program.

Figure 15: Framework for model development for the Voluntary program

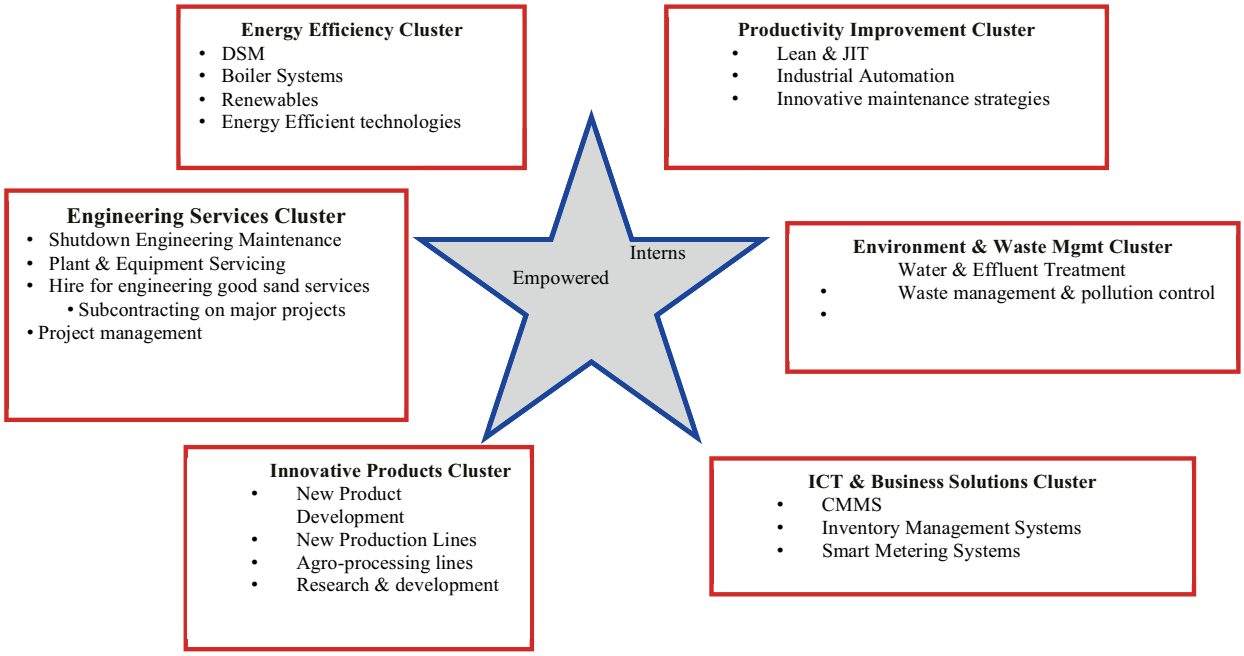


The key stakeholders in resource mobilisation include the government and developmental partners. The key Ministries include MoHTESTD through ZimDef, the MoIC, MoSMEs and MoYIEE through the Youth Development Fund. Several NGOs and developmental partners also exist with mandates in promoting employment creation and sustainable livelihoods and they can become handy in mobilising resources. Regulatory Agents with funding may also be useful, for example EMA, ZERA and REA since the high impact issues addressed by the interns like energy efficiency, environment, water, sanitation and hygiene and import substitution may be directly related to their mandates. Professional bodies like ECZ, ZIE, ZACE, etc as well as training institutions like UZ, NUST, SIRDC, etc may help with mentorship, whilst representative bodies like EISAZ, CZI, CoM, etc may help with administration of the voluntary program, The Voluntary Program could easily be scaled up and has the potential of enhancing the human capital and technical capacity development of the nation, technology based industrialisation, import substitution and ultimately improving the industrial sector of the economy.

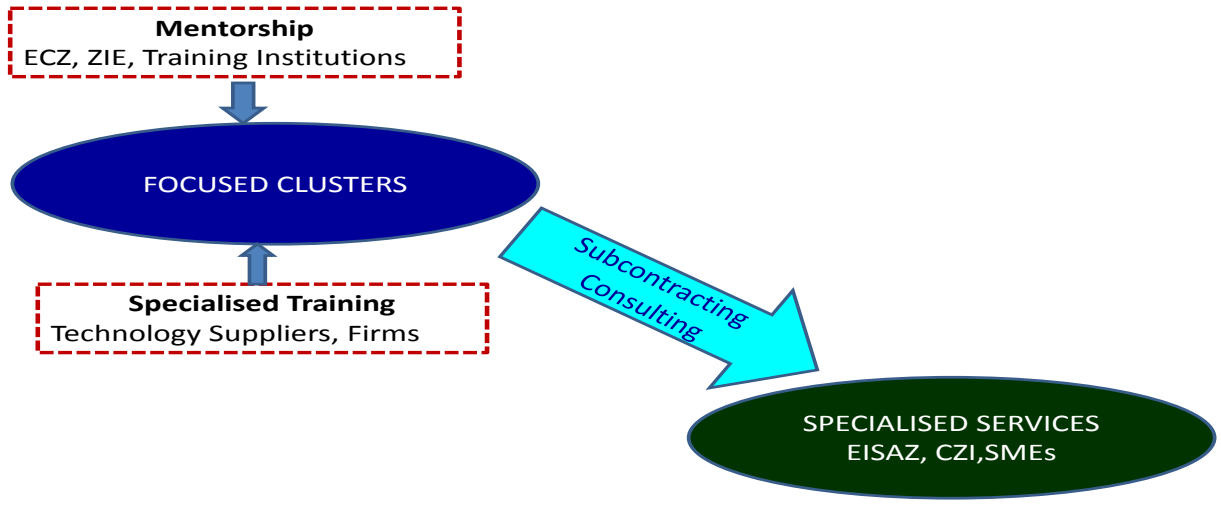
Creation of Flexible Clusters to Solve Common Problems with High Impact

Also looking beyond the pilot program, flexible clusters can be formed to solve common problems and hence improve productivity and capacity of the industry. From the challenges and problems that were identified by the interns, potential clusters were identified. The clusters are presented in Figure 16.

Figure 16: Flexible Clusters for solving cross cutting problems



The framework for development of implementable models for Intern clusters is presented in Figure 17 below.**Figure 17: framework for development of implementable models for Intern clusters**

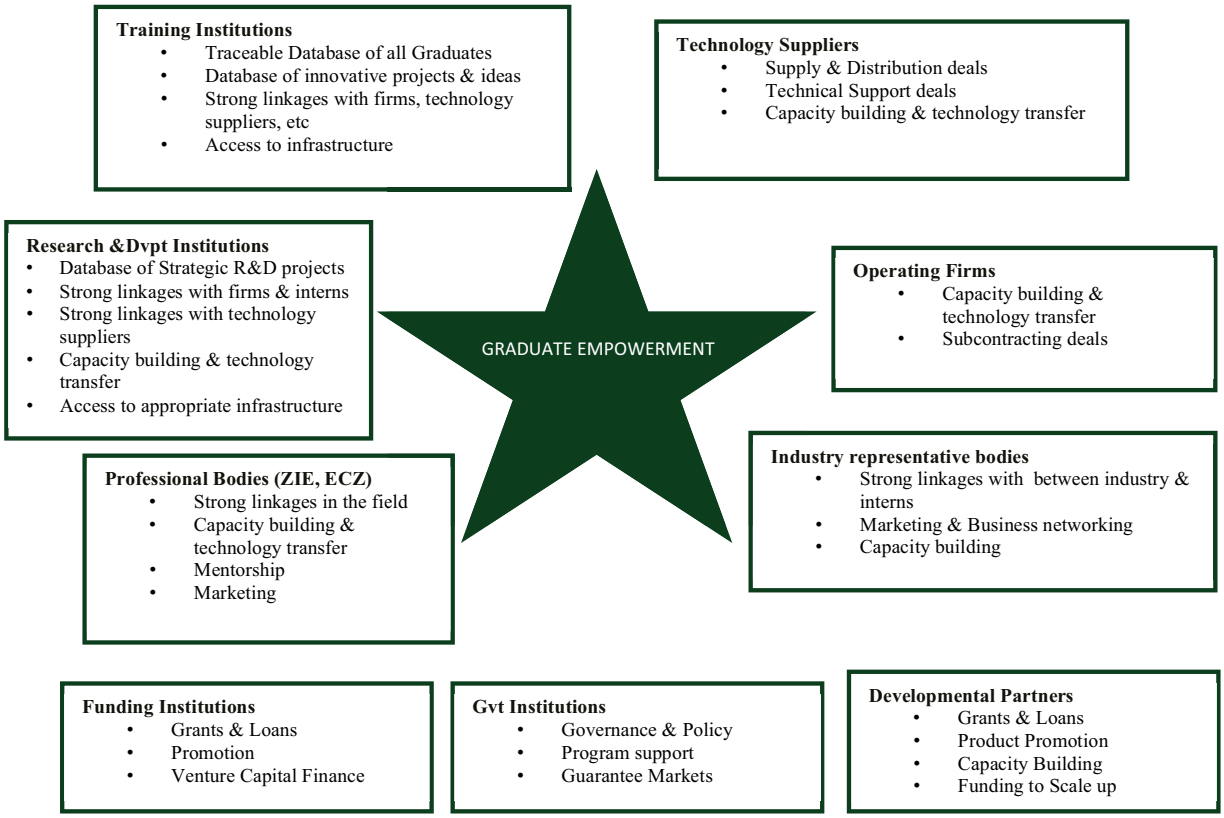


The main services that can be offered by the interns will be through subcontracting and consultancy in the identified areas of intervention. Interns with common skills will form focused clusters that are institutionalised and mentored by senior engineers, technocrats and specialist. The interns may receive specialised training from technology suppliers, training institutions and firms in a win-win scenario, and procurement of services to client base may be facilitated through representative bodies like EISAZ, CZI, SMEAZ, etc. The services may also be marketed and promoted via the sector representative bodies.

Development of Sustainable Youth Empowerment Models through technology transfer

A framework for the development of sustainable youth empowerment model through technology transfer requires a holistic approach involving all stakeholders. The preliminary framework is presented in Figure 18 below.

Figure 18: Framework for development of sustainable model for youth empowerment through technology transfer



6.4 Possible entrepreneurship Models

The stakeholder workshops with firms and interns showed that entrepreneurship was not easy as it involved many factors which could not necessarily be obtained within the three month internship period. This include the current mind-set of the interns, who are mainly employment oriented and would only get into entrepreneurship due to limited employment opportunities. The limited funding as well as the specialised nature of services required in the form of human and technical capacity to deliver are also obstacles towards entrepreneurship. However, there are three possible approaches that were proposed for entrepreneurship to succeed as follows:

i) Empowered graduates act in their individual capacity post internship to deliver a service to targeted firms by being offered service specific contracts;

ii) Empowered graduates form a company that offers specialised services to target companies at competitive rates. This would see the interns offering a range of services depending on the technology that they were subjected to during the internship period;

iii) Empowered graduates form joint ventures with existing firms for offering new products and services.

It is anticipated that mobilising resources becomes easier in the joint venture approach with established firms. The targeted firms may also help with technical capacity for empowered graduates, e.g. availing machinery and workshops, availing underutilised production lines, technical resources like artisans as well as funding. Because of the already established linkage between the interns and the firms, the latter can provide markets or subcontracts along their supply/value chain with greater confidence. Banks and debt financiers can also become more confident in funding such arrangements. However, for this to succeed, it is mainly the interns who would be expected to take a leading role, which could be affected by mind-sets.

7. CHALLENGES AND SHORTCOMINGS OF THE PROJECT

Implementation time frame of the pilot project

There was a general agreement among the graduates and firms that offered internship placement to the graduates that the pilot program was very short. Some firms already have trainee programs that run for at least 12 months and as a result they preferred giving internship for graduates who stayed longer than those that the project was sponsoring for three months. One of the limitations of a short internship period was that the interns would not be able to fully benefit from the training they get from the companies. Most of the projects that the graduates were working on at the companies they were attached would not be completed during the three months internship. Consequently, this means that they could not demonstrate the benefits of projects with a longer gestation period to the companies, and for those who wish to pursue entrepreneurship they would have missed an opportunity of demonstrating the impact of their projects.

Challenges in getting the graduates to participate in the pilot project

The project had initially planned to get the graduates for the internship through training institutions. However, it was not easy to get the graduates from training institutions due to a number of challenges. Most of the training institutions do not keep a database of their graduates and they do not track whether they are employed or not. In other countries, for example South Africa, there is a database of graduates from tertiary institutions which enable the country to do skills planning. Such database enables them to determine the number of skills they have, the number of skills required, the skills gap, and the number of skills to be imported, among others. Some training institutions required a memorandum of understanding in order for them to avail their databases of graduates, but this was not efficient as it lengthened the process of getting potential graduates on board for internship. In some cases there was sheer lack of cooperation from some training institutions as attempts to set up meetings with them to explain the project and get potential graduates were not granted. Moreover, contact details of some training institutions are very inaccessible as they do not have functional websites and their telephones do not get answered. Some of the potential graduates which were suggested by training institutions could not be contacted successfully as they reside in rural areas where there are cellular network problems and lack of electricity to recharge their phones.

Scepticism about the project

At first some firms did not clearly understand what the project was all about. The term 'youth empowerment' seemed to be associated with national youth program run by the government. As a result some companies were reluctant to participate through giving internship placement to the graduates. Some companies were also querying the selection process of the graduates indicating that they had their own selection process.

Challenges on placing graduates on internship

The pilot project sought to attach graduates to companies that are relevant to the training they received and the projects they did in their final year of training. However, several challenges were faced in trying to get the graduates placed for internship. Some companies were not keen to cooperate in the pilot project because of the scepticism they had about the project. Several attempts were made to set up meetings to explain the purpose of the project and request their cooperation but they did not yield any positive results. In some cases companies were willing to place the students for internship but they could not do so because they were operating far below capacity to the extent that the graduates would not benefit anything from the internship.

One of the reasons why it was difficult to get companies to participate was the inappropriate point of entry into the companies through the human resources department. Almost all the initiatives to place the graduates on internship through approaching the human resources department were unsuccessful. However, approaching the chief executive officers proved to be very successful and efficient in getting the graduates placed for internship. The chief executive officers would make the decision and direct the human resources department to action.

Insurance cover

In an engineering environment it is not uncommon for casualties to occur. Some companies raised issues on how the graduates will be insured should they get involved in accidents at the workplace. Since the graduates were not employees of the companies they were attached to, they were not covered in the event of getting involved in workplace accidents. The pilot project also did not cover the graduates, thus leaving them exposed.

Drop outs

Some of the graduates who were initially enrolled on the project did not continue up to the end of project. Some signed contracts but dropped out before they even started citing challenges in securing accommodation in cities/towns they were deployed. Some dropped off as they got other opportunities. The drop outs that occurred after the project had started had to be replaced by other new graduates. This even worsened the challenge of limited time for the pilot project as the new graduates had to participate for less than the planned three months.

Issues of intellectual property rights

Since the project targeted graduates who had demonstrated their innovativeness through projects they developed in their final year of study with potential for industrial application or entrepreneurship, most of the training institutions highlighted that there could be issues of intellectual property rights violation. When graduates get internship and develop innovative products they risk losing the products to the companies if there are no proper mechanisms in place to ensure fair distribution of benefits arising from their innovativeness at the companies. On the other hand, the training institutions also highlighted that companies risked having their proprietary information stolen by the graduates if appropriate measures are not put in place. Training institutions were also concerned that some of the graduates' projects which were developed during their final year of study had significant contribution from lecturers, hence also wanted a mechanism for their recognition in those projects if they are going to be implemented through companies at which the graduates get attached.

In order to circumvent some of the intellectual property right concerns, suggestions were made that non-disclosure agreements be signed between students and companies to avoid scenarios were companies would lose their proprietary information to the graduates. Suggestions were also made that, in the event of a new product being developed by the graduate with the assistance of the company, the graduate and the company should enter into an agreement that ensures that the graduate also benefit from the product through arrangements such as royalty fees. The graduates were also oriented on these issues at the beginning of the program.

Short time frame to engage financial institutions

At design, it had been expected that financial institutions would develop an interest in the project, especially as there were opportunities for them to finance the projects. However, the financial institutions could not be adequately mobilised within the short time frame, especially since most of the projects that needed to be funded had not yet matured. This implies that the interns and those who partnered them in developing the projects will need to engage the financial institutions outside the implementation period of the project.

8. OVERALL ASSESSMENT OF THE PROJECT

The pilot project was generally successful in demonstrating the extent to which technology transfer can play a role in enhancing youth empowerment and entrepreneurship. The following can be regarded as the overall assessment of the extent to which the project was able to meet its intended objectives:

i. **Promoting technology transfer and adoption**

There is general consensus among the participating interns and the hosting firms that the project was able to enhance technology transfer within the short time period. The interns are now equipped with the technological skills and knowledge through exposure to the current technologies being used in the industries under which they were hosted. Based on the projects which the interns developed for the firms as well as other projects which the interns would be prepared to continue to exploit outside the hosting firms, it is quite apparent that there has been technological diffusion to the interns, which is now part of their intellectual endowment.

While there has been technological transfer, full absorption could not be totally achieved within the short time frame. Thus, the interns still need more exposure under similar environment to be totally conversant of the technologies that are currently being employed in the hosting firms.

Facilitating linkages between technology suppliers; financial institutions and the youth exposed to current technology and production processes

Given the short time frame, the engagement with financial institutions could not be facilitated as part of the project. As a result, financial institutions were only invited at the end of the project, at which there was little time for them to interact with the interns to advise them on how best to make their projects bankable. Thus, at the time that the pilot project closed, it had not yet been able to link up the youths with the financial institutions as originally envisaged.

ii. **Contribute to knowledge on alternative and innovative models of youth empowerment**

The pilot project was an eye opener as it was able to demonstrate that it is possible to utilise currently unemployed graduates to solve some of the existing problems. The project was able to reveal that due to funding challenges, most of the firms have abandoned their R & D departments and mostly rely on using out-dated and old fashioned manual systems. Internships can thus be used as an avenue for enhancing productivity and reducing costs, while at the same time enhancing the capacity of the youth to engage in entrepreneurship or to enhance employability chances. Thus, youth empowerment in Zimbabwe can be viewed under this perspective, where trained youths who are currently unemployed can be utilised for problem solving and innovation while exposing them to technologies which empowers them. The project thus can be regarded as having succeeded in generating this knowledge.

iii. **Empower the selected youth with entrepreneurial and technological skills**

As already intimated, the project was able to enhance the technological skills of the youths and was thus successful in this respect. However, while the technological skills were enhanced, the same cannot be said with respect to entrepreneurship skills. There was not adequate time for the youths to get exposure on entrepreneurship, which would go beyond the technical skills to also include project management, proposal development and marketing skills. Thus, while there is a lot of potential with respect to entrepreneurship, there is a limit to the extent to which the potential can be exploited, given that the youths still lack entrepreneurship skills.

iv. **Assessing the relevance and effectiveness of existing technology training and manpower development programs**

The project was also expected to be instrumental in assessing the implications of the technical capacity of the interns training with respect to the relevance and effectiveness of the current training institution curricular. While there was general consensus among the interns that the level of technology that they were exposed to was new, it was not very difficult for them to adapt and adopt given that the training institutions had adequately prepared them to adapt. However, it also came out during the project that the training institutions lack the

facilities to equip the students with the practical skills unless they enrol in such technologically endowed firms during attachment. Thus, the need to review the curricular to ensure that the students are at least exposed to the technology during lectures was identified during the project.

v. **Matching skills of trained and unemployed youths to appropriate technology**

The matching was successfully done under the project as each intern was placed in a firm where they were better placed to learn and quickly adapt to the technology in use. However, some possible interns were left out of the project due to the reluctance by the firms that had been identified to participate in the project. This also limited the extent to which some technological skills related to the food processing industry could be transferred.

9. RECOMMENDATIONS FOR FUTURE PROJECTS

The pilot project has generally revealed that if appropriately structured, it is possible to enhance entrepreneurship and empowerment through technology transfer by implementing a similar model. However, the following are some of the critical issues for such a model to have higher chances of success compared to the current model:

- There is need for a longer internship period compared to the current three months. Based on the nature of the projects which the interns developed under the project which, if implemented, would go a long way in solving some of the productivity challenges currently bedevilling industry, an internship period ranging from six months to a year would be more appropriate.

- The project idea needs to be communicated well in advance to all the stakeholders that are expected to have a role to play in enhancing its success. This would require financial institutions as well as development partners that currently implement youths' empowerment projects to be well aware of the project for them to play a supporting role, especially when it comes to entrepreneurship. The entrepreneurship preparations should commence with the internship, so that the intern is adequately prepared to conceive proper ideas which can be easily bankable to ensure that the technology gained is used in entrepreneurship.

- Intellectual property rights need to be carefully incorporated into any similar project to ensure that those who have a role to play in the development of the projects and products are adequately protected. Polytechnic colleges and some universities refused to participate as they felt that some of the ideas that the students would be testing under the internship might have originated from the lecturers. Thus, the training institutions would also want their due acknowledgement and protection as the products developed enter into the market. While it is important that an intellectual property rights regime be worked out prior to the commencement of the internship, the issue could easily derail the success of the project if the hosting firms and the students are demotivated by their inclusion.

- The incorporation of AA Mines and EISAZ to help mobilise firms to agree to the internship was instrumental to the success as the firms just agreed even under difficult conditions. It is important for any future project to ensure that there is insurance risk cover for the students, as currently there were no explicit specifications as to who would become liable if the interns would be involved in accidents or fall sick during internship. Fortunately, this did not arise during the course of the internship.

- The success of this pilot project has provided ample evidence through the projects undertaken by Interns that scaling up of this initiative has multiple benefits for the economy and can facilitate development of synergistic relationship among different institutions committed to addressing youth unemployment. Youth empowerment through technology transfer can be used as a key strategy for reaping the demographic dividend. In this regard, it is recommended to ACBF to consider supporting a full blown project on Youth Empowerment through Technology Transfer. This project can be spearheaded by ZEPARU and implemented in partnership with multiple stakeholders, including Business Membership Organisation; Ministry of Youth Indigenisation and Economic Empowerment; other Development Partners; Training Institutions and the Participating Firms.

- There is also need to explore ways of building a revolving fund that will help institutionalise support for empowerment and entrepreneurship through Technology Transfer and expand the number of beneficiaries given the extent of unemployment among youth with technology training.

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APPENDIX 11: PICTURE GALLERY

1. FICAD INTERN FEEDBACK WORKSHOP, HOLIDAY INN, HARARE

Dr. G. Chigumira (ZEPARU Executive Director giving opening remarks at the Intern Feedback Workshop, held in Harare.

Tinashe Bvunzawabaya, (FICAD Intern) giving a presentation of his Internship experience at ZimPhos

FICAD Interns following proceedings during the Interns Feedback Workshop, Holiday Inn, Harare

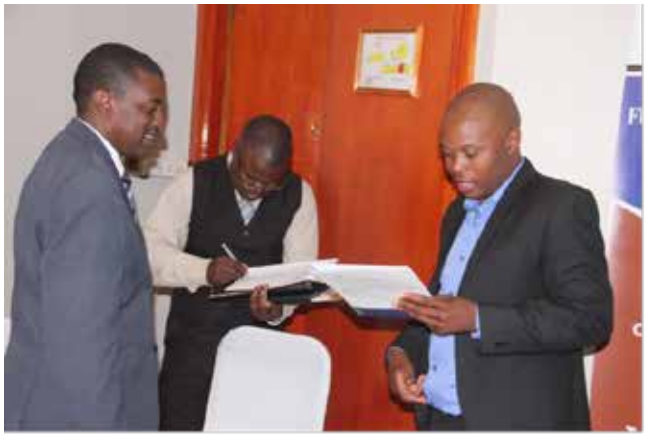
Harare Interns Feedback Workshop Group Photo

Zvishavane, Mashava and Bulawayo Interns Feedback Workshop Group Photo

2. INTERN HOSTING FIRMS BREAKFAST MEETING, CROWNE PLAZA, HARARE

Engineer A. Tigere (EISAZ President) shares a lighter moment with Mr. E. Mwinga (Cernol Chemicals) and M. Gavhure (Chemplex Corporation) at the Breakfast meeting.

Mr. Manjoro (Twenty Third Century Systems), Mr. L. Jiri (Greif Zimbabwe) and Engineer L. Nyemba (ZEPARU Consultant) sharing views at the Breakfast meeting.



Delegates at the Intern Hosting Firms Breakfast meeting held in Harare,

Engineer A. Tigere (EISAZ President), Mr. E. Mwinga (Cernol Chemicals) M. Gavhure (Chemplex Corporation) and Engineer Zvarevashe (Jacob Bethel Corporation) at the Breakfast meeting.

Mr. M. Chinake and Mr. Nyamunama both from Precision Grinders with Ms L. Maringamoyo (Clarson and Company at the Breakfast meeting.

3. FICAD CONFERENCE, 30 AUGUST 2017, CROWNE PLAZA, HARARE

Dr. R. Atindehou (Director, Department of Operations at ACBF) welcomes Dr. D. Sibanda (Perm Secretary, Ministry of Youth Indigenisatic and Economic Development) to the FICAD conference while Dr. G. Chigumira(Executive Director, ZEPARU) looks on.

Dr. D. Sibanda (Perm Secretary, Ministry of Youth Indigenisation and Economic Development), Dr. R. Atindehou (Director, Department of Operations, ACBF) and Dr. G. Chigumira (Executive Director, ZEPARU) giving remarks during the conference.

Delegates and Interns following proceedings during the FICAD Conference

Professor L. Tichagwa (Harare Institute of Technolo her insights of the FICAD projects during the disc session

Dr Siaka Coulibaly (Senior Program Officer, ACBF), Interns and delegates following conference proceedings

Interns Poster Presentation Session at the FICAD Conference held in Harare

FICAD Conference Group Photo, 30 August, 2017, Crowne Plaza Hotel, Harare.

From left: Dr. G. Chigumira(ZEPARU), Dr. R. Atindehou (ACBF), Dr. D. Sibanda (MYIED) and Dr. S. Coulibaly (ACBF).