

# The Effect of Industrial Revolution 4.0 on Social Entrepreneurship in Malaysia; Evidence of Neurocomputing Analysis on Contributing Factors Towards Tertiary Level Students' Readiness

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**Abstract**— The world is growing quick because of the innovative insurgency that incredibly impacts our method for living and the conduct of the two people and associations. Industry 4.0 (otherwise called Fourth Industrial Revolution) shows itself in the manner in which information changes, advancements are robotized and digitized, and what we currently call the Internet of things (IoT). Instruction suppliers is presently taking a gander at eight 4.0 transformational needs by looking at the customary and old economy, and the troublesome and new economy. Beforehand the economy was assets centered, the new economy is learning serious; in the past it was work escalated, now it requires high gifted ability; and once requiring control, the new economy requests joint effort. In this research, artificial neural network is adapted to rank the importance of contributing factors which influence the students' readiness toward social entrepreneurship and innovation among Malaysian undergraduate students. A population of N=127 undergraduate students of Bachelor of Social Entrepreneurship were taken. The models is highly significant at  $p=0.000$  ( $RE=0.794$ ) with 13-4-1 configurations respecting to input-hidden-output nodes. Eventually, it is found that the top five most essential factors which influence students' readiness toward social entrepreneurship and innovation are moral obligations, self-efficacy, prior knowledge, career adaptability and empathy accordingly. As a conclusion, this research parallel to the Economic Transformation Programme enroute to the 2050 National Transformation which is the country's vision of being among the top countries in the world in economic development, citizen well-being and innovation.

**Keyword** - Industrial Revolution 4.0, Social Entrepreneurs and Innovation, Tertiary, Undergraduates, Malaysia.

## I. INTRODUCTION

T Industry 4.0 is identified with what is known as the "savvy manufacturing plant" (Dutton, 2014). In a brilliant industrial facility, a virtual duplicate of the physical world and decentralized basic leadership can be produced (Buhr, 2015). Additionally, physical frameworks can participate and speak with each other and with people progressively, all empowered by the IoT and related administrations.

The discussion about Industry 4.0 and its worldwide effect is becoming quickly because of serious dialogs about digitization, the Internet of things, and savvy learning and frameworks (Friess and Ibanez, 2014; Vermesan et al., 2014). The discussion is driven by vulnerability about the most ideal approach to misuse the quick pace of mechanical advancement to enhance different parts of human life.

The idea of Industry 4.0 has its inceptions in Germany and has been perceived by other driving mechanical countries, despite the fact that it is known as "Associated Enterprise" in the United States and the "Fourth Industrial Revolution" in the United Kingdom. Regardless, Industry 4.0 is based on three going before innovative changes: steam control, which was the transformative power of the nineteenth century; power, which changed a significant part of the twentieth, and the time of the PC start of 1970s (Cordes and Stacey, 2017). We

expect that the effect of Industry 4.0 will be more significant, irreversible, and substantially more fast than the past three ages. The high development in the request of innovations (fundamentally data and correspondence advances) by mechanical firms can fuel the eventual fate of Industry 4.0 and may result in positive overflow impacts to various regions.

The expression "Business 4.0" was begun in 2011 at the Hanover Fair in Germany as a procedure to relieve the expanding rivalry from abroad and to separate German and European Union ventures from other universal markets (Pascall, 2017). Additionally, the German government tried to utilize wise observing underway procedures so as to help basic leadership and machine support to decrease expenses and increment the intensity of German enterprises. With a specific end goal to comprehend what is implied by Industry 4.0, PwC (2017) proposed a system, which likewise was received by the Flemish Government. The possibility of the system emerged by requesting that driving organizations decide their needs among a gathering of ideas. Brilliant frameworks, people in Industry 4.0, shrewd creation, and relationship building abilities were recognized as the most astounding needs.

Acatech (2014) portrayed Industry 4.0 as the IoT: information and administrations that will change future generation, coordinations, and work forms. This implies the advancement of the IoT has gone past Internet-associated applications lately with the joining of various advances, for example, machine learning, installed frameworks, and remote association. The European Research Cluster on the Internet of Things (IERC) (Vermesan et al., 2009) expressed that the IoT is "an incorporated piece of Future Internet and could be characterized as a dynamic worldwide system foundation with self-arranging capacities in view of standard and interoperable correspondence conventions where physical and virtual 'things' have personalities, physical traits, and virtual identities and utilize insightful interfaces, and are consistently coordinated into the data organize." IERC included that "things" in the IoT "are relied upon to end up dynamic members in business, data and social procedures where they are empowered to associate and convey among themselves and with the earth by trading information and data 'detected' about the earth, while responding independently to the 'genuine/physical world' occasions and affecting it by running procedures that trigger activities and make administrations with or without coordinate human intercession". Vermesan et al. (2014) affirmed that the principle objective of the IoT is to "empower things to be associated whenever, wherever, with anything and anybody in a perfect world utilizing any way/organize and any administration".

## II. RELATED LITERATURES

Industry 4.0 is exceptionally associated with development. In the most recent decade, advancement added encourage fixings to the blend – versatile, cloud, web-based life, and enormous information – which together may fabricate an immaculate advantageous interaction, make new idea for the industrialization procedure, and move the market into new period of rivalry and separation of items (Geiger and Sá, 2013). Industry 4.0 speaks to a move toward an advancement based economy with information, information, and the IoT as focal ideas. This will influence the present structure, markets, and business procedures of the modern age and prepare to another period of digitization, "more quick witted" systems administration of creation frameworks, and interlinked business forms.

A large portion of the ongoing writing about the Fourth Industrial Revolution centers around the mechanical advancement nature of Industry 4.0. There is worry about whether the quick development in innovative improvement and digitization is leaving a positive effect on the people and society (Luppicini, 2012). In this manner, while considering how mechanical advancement can be misused to take care of society issues, we should likewise see mechanical developments through a social point of view.

Industry 4.0 spoken to by the high development in innovation empowered stages has disturbed the current business structures and made better approaches for expending merchandise through the blend of interest and supply. It likewise sorts out how individuals function and expend, it changes the idea of benefits, and it influences how information is gotten and controlled. Also, it brings down the obstructions for individuals and organizations to contribute and make riches, which thus adjusts the encompassing individual and expert situations (Schwab, 2015).

### III. DATA BACKGROUND

A population of N=127 undergraduate students of Bachelors of Social Entrepreneurship at University Malaysia Kelantan were taken. The descriptive statistics can be seen in Table 1.

TABLE I. Descriptive Statistics

	Mean	Std. Deviation	N
Readiness Intention	4.6037	.38657	127
Gender	1.7008	.45973	127
Ethnic Group	1.4331	.84130	127
Age	1.2756	.55887	127
Current Study Program	2.1969	.59147	127
Current Year of Study	2.1024	.79517	127
Field of Study	1.0866	.28238	127
Empathy	4.2913	.58304	127
Moral Obligation	4.4606	.54045	127
Self Efficacy	4.0039	.59760	127
Social Support	3.9764	.57858	127
Prior Knowledge	3.7717	.79246	127
Entrep Alertness	3.8928	.58576	127

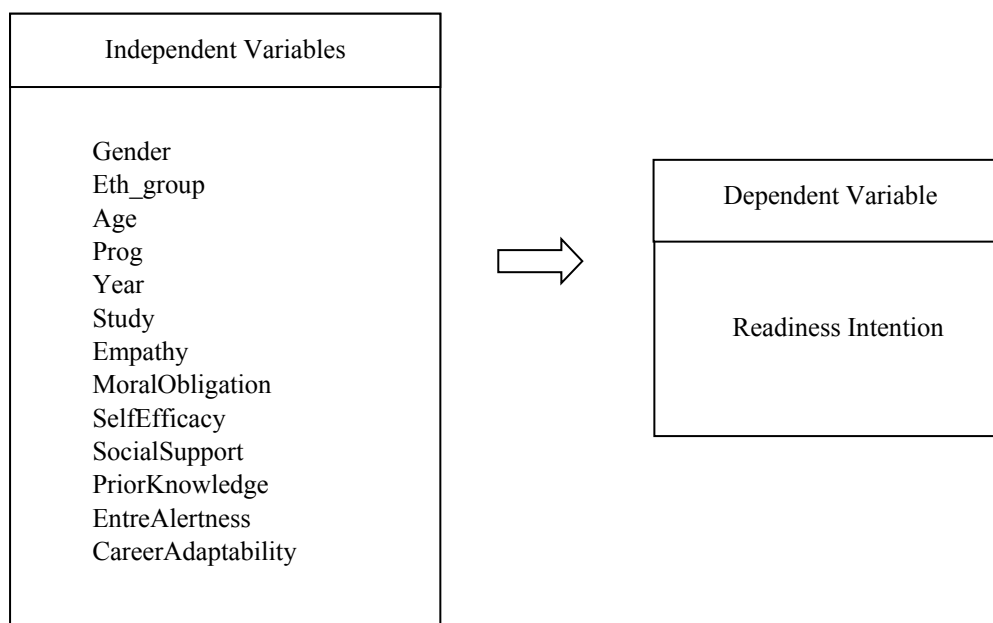


Fig.1. Theoretical Framework

### IV. METHODOLOGY

In this research, we adapted two-layer neural network, with tangis transfer function in the first layer and purelin transfer function at the second layer. Trainscg is the training function used in this research, with MSE equals to 0.0 as the criterion function. The data are partitioned into three different sets which are training (70%), validation (30%) and testing (30%) sets. A nonlinear model that contains more than one predictor variable neural network is developed in this research. Fig.1. illustrates the theoretical framework of this research in order to achieve the main objective. The following model is a neural network model with 13 predictor variables,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$ ,  $\beta_5$ ,  $\beta_6$ ,  $\beta_7$ ,  $\beta_8$ ,  $\beta_9$ ,  $\beta_{10}$ ,  $\beta_{11}$ ,  $\beta_{12}$ , and  $\beta_{13}$ .

$$Y = \text{purelin} \left[ \begin{array}{l} LW^{2.1} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \beta_1 + (IW_2)^{1.2} * \beta_2 + (IW_3)^{1.3} * \beta_3 + \\ (IW_4)^{1.4} * \beta_4 + (IW_5)^{1.5} * \beta_5 + (IW_6)^{1.6} * \beta_6 + \\ (IW_7)^{1.7} * \beta_7 + (IW_8)^{1.8} * \beta_8 + (IW_9)^{1.9} * \beta_9 + \\ (IW_{10})^{1.10} * \beta_{10} + (IW_{11})^{1.11} * \beta_{11} + (IW_{12})^{1.12} * \beta_{12} + \\ (IW_{13})^{1.13} * \beta_{13} + \varepsilon^2 \end{array} \right\} + \\ LW^{2.2} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \beta_1 + (IW_2)^{1.2} * \beta_2 + (IW_3)^{1.3} * \beta_3 + \\ (IW_4)^{1.4} * \beta_4 + (IW_5)^{1.5} * \beta_5 + (IW_6)^{1.6} * \beta_6 + \\ (IW_7)^{1.7} * \beta_7 + (IW_8)^{1.8} * \beta_8 + (IW_9)^{1.9} * \beta_9 + \\ (IW_{10})^{1.10} * \beta_{10} + (IW_{11})^{1.11} * \beta_{11} + (IW_{12})^{1.12} * \beta_{12} + \\ (IW_{13})^{1.13} * \beta_{13} + \varepsilon^2 \end{array} \right\} + \\ LW^{2.3} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \beta_1 + (IW_2)^{1.2} * \beta_2 + (IW_3)^{1.3} * \beta_3 + \\ (IW_4)^{1.4} * \beta_4 + (IW_5)^{1.5} * \beta_5 + (IW_6)^{1.6} * \beta_6 + \\ (IW_7)^{1.7} * \beta_7 + (IW_8)^{1.8} * \beta_8 + (IW_9)^{1.9} * \beta_9 + \\ (IW_{10})^{1.10} * \beta_{10} + (IW_{11})^{1.11} * \beta_{11} + (IW_{12})^{1.12} * \beta_{12} + \\ (IW_{13})^{1.13} * \beta_{13} + \varepsilon^2 \end{array} \right\} + \\ LW^{2.4} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \beta_1 + (IW_2)^{1.2} * \beta_2 + (IW_3)^{1.3} * \beta_3 + \\ (IW_4)^{1.4} * \beta_4 + (IW_5)^{1.5} * \beta_5 + (IW_6)^{1.6} * \beta_6 + \\ (IW_7)^{1.7} * \beta_7 + (IW_8)^{1.8} * \beta_8 + (IW_9)^{1.9} * \beta_9 + \\ (IW_{10})^{1.10} * \beta_{10} + (IW_{11})^{1.11} * \beta_{11} + (IW_{12})^{1.12} * \beta_{12} + \\ (IW_{13})^{1.13} * \beta_{13} + \varepsilon^2 \end{array} \right\} + \varepsilon^2 \end{array} \right] \quad (1)$$

In this research, the general model is

$$\text{ReadinessIntention} = \text{purelin} \left[ \begin{array}{l} LW^{2.1} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \text{Gender} + (IW_2)^{1.2} * \text{Eth\_Group} + (IW_3)^{1.3} * \text{Age} + (IW_4)^{1.4} * \text{Pr og} \\ + (IW_5)^{1.5} * \text{Year} + (IW_6)^{1.6} * \text{Study} + (IW_7)^{1.7} * \text{Empathy} + (IW_8)^{1.8} * \text{MoralObligation} \\ + (IW_9)^{1.9} * \text{SelfEfficacy} + (IW_{10})^{1.10} * \text{SocialSupport} + (IW_{11})^{1.11} * \text{Pr iorKnowledge} \\ + (IW_{12})^{1.12} * \text{EntepAlertness} + (IW_{13})^{1.13} * \text{CareerAdaptability} + \varepsilon^2 \end{array} \right\} + \\ LW^{2.2} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \text{Gender} + (IW_2)^{1.2} * \text{Eth\_Group} + (IW_3)^{1.3} * \text{Age} + (IW_4)^{1.4} * \text{Pr og} \\ + (IW_5)^{1.5} * \text{Year} + (IW_6)^{1.6} * \text{Study} + (IW_7)^{1.7} * \text{Empathy} + (IW_8)^{1.8} * \text{MoralObligation} \\ + (IW_9)^{1.9} * \text{SelfEfficacy} + (IW_{10})^{1.10} * \text{SocialSupport} + (IW_{11})^{1.11} * \text{Pr iorKnowledge} \\ + (IW_{12})^{1.12} * \text{EntepAlertness} + (IW_{13})^{1.13} * \text{CareerAdaptability} + \varepsilon^2 \end{array} \right\} + \\ LW^{2.3} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \text{Gender} + (IW_2)^{1.2} * \text{Eth\_Group} + (IW_3)^{1.3} * \text{Age} + (IW_4)^{1.4} * \text{Pr og} \\ + (IW_5)^{1.5} * \text{Year} + (IW_6)^{1.6} * \text{Study} + (IW_7)^{1.7} * \text{Empathy} + (IW_8)^{1.8} * \text{MoralObligation} \\ + (IW_9)^{1.9} * \text{SelfEfficacy} + (IW_{10})^{1.10} * \text{SocialSupport} + (IW_{11})^{1.11} * \text{Pr iorKnowledge} \\ + (IW_{12})^{1.12} * \text{EntepAlertness} + (IW_{13})^{1.13} * \text{CareerAdaptability} + \varepsilon^2 \end{array} \right\} + \\ LW^{2.4} \tanh \left\{ \begin{array}{l} (IW_1)^{1.1} * \text{Gender} + (IW_2)^{1.2} * \text{Eth\_Group} + (IW_3)^{1.3} * \text{Age} + (IW_4)^{1.4} * \text{Pr og} \\ + (IW_5)^{1.5} * \text{Year} + (IW_6)^{1.6} * \text{Study} + (IW_7)^{1.7} * \text{Empathy} + (IW_8)^{1.8} * \text{MoralObligation} \\ + (IW_9)^{1.9} * \text{SelfEfficacy} + (IW_{10})^{1.10} * \text{SocialSupport} + (IW_{11})^{1.11} * \text{Pr iorKnowledge} \\ + (IW_{12})^{1.12} * \text{EntepAlertness} + (IW_{13})^{1.13} * \text{CareerAdaptability} + \varepsilon^2 \end{array} \right\} + \varepsilon^2 \end{array} \right] \quad (2)$$

The final model will include only the significant predictors to describe Total Mark. Table 2 also represents the variables used in this research as well as the explanations of each variable.

TABLE II. Variables of Interest

<b>Dependent Variable</b>	<b>Notation</b>	<b>Type</b>
Readiness Intention	Readiness Intention	Continuous
<b>Independent Variables</b>	<b>Notation</b>	<b>Type</b>
Gender	Gender	Catagorical
Ethnic Group	Eth_Group	Catagorical
Age	Age	Continuous
Current Study Program	Prog.	Catagorical
Current Year of Study	Year	Continuous
Field of Study	Study	Catagorical
Empathy	Empathy	Continuous
Moral Obligation	Moral Obligation	Continuous
Self-Efficacy	Self Efficacy	Continuous
Social Support	Social Support	Continuous
Prior Knowledge	Prior Knowledge	Continuous
Entrepreneurship Alertness	Entrep Alertness	Continuous
Career Adaptability	Career Adaptability	Continuous

**V. RESULT**

Based on Table 3, in the preprocessing part, the data were divided into two sets; training and testing. Training set consist of 68.5 % (87/127) of the overall data, while testing sets comprises of 31.5 % (40/127) of the overall data, N=127. There were no missing values recorded.

TABLE III. Case Processing Summary

<b>Data Partitioning</b>		<b>N</b>	<b>Percent</b>
Sample	Training	87	68.5%
	Testing	40	31.5%
Valid		127	100.0%
Excluded		0	
Total		127	

Table 4 shows the overall network information. The covariates to the network were Gender, Ethnic Group, Age, Current Study Program, Current Year of Study, Field of Study, Empathy, Moral Obligation, Self-Efficacy, Social Support, Prior Knowledge, Entrepreneur Alertness and Career Adaptability. These 13 covariates were the inputs nodes in the input layer of the network. This network consists of only one hidden layer, with four nodes. The activation function from input layer to hidden layer was hyperbolic tangent. The target of the network is Readiness Intention, where the activation function from hidden layer to output layer was identity (purelin). The default error function in backpropagation neural network was based on sum of squares (SSE). To simplify, the configurations of this network was 13-4-1. The network architecture can be referred in Figure 2.

TABLE IV. Network Information

<b>Input Layer</b>	<b>Covariates</b>	1	Gender
		2	Ethnic Group
		3	Age
		4	Current Study Program
		5	Current Year of Study
		6	Field of Study
		7	Empathy
		8	Moral Obligation
		9	Self Efficacy
		10	Social Support
		11	Prior Knowledge
		12	Entrep Alertness
		13	Career Adaptability
Number of Units* <sup>a</sup>		13	
Rescaling Method for Covariates		Standardized	
<b>Hidden Layer(s)</b>	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1* <sup>a</sup>		4
	Activation Function		Hyperbolic tangent
<b>Output Layer</b>	Dependent Variables	1	Readiness Intention
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares

\*a Excluding the bias unit

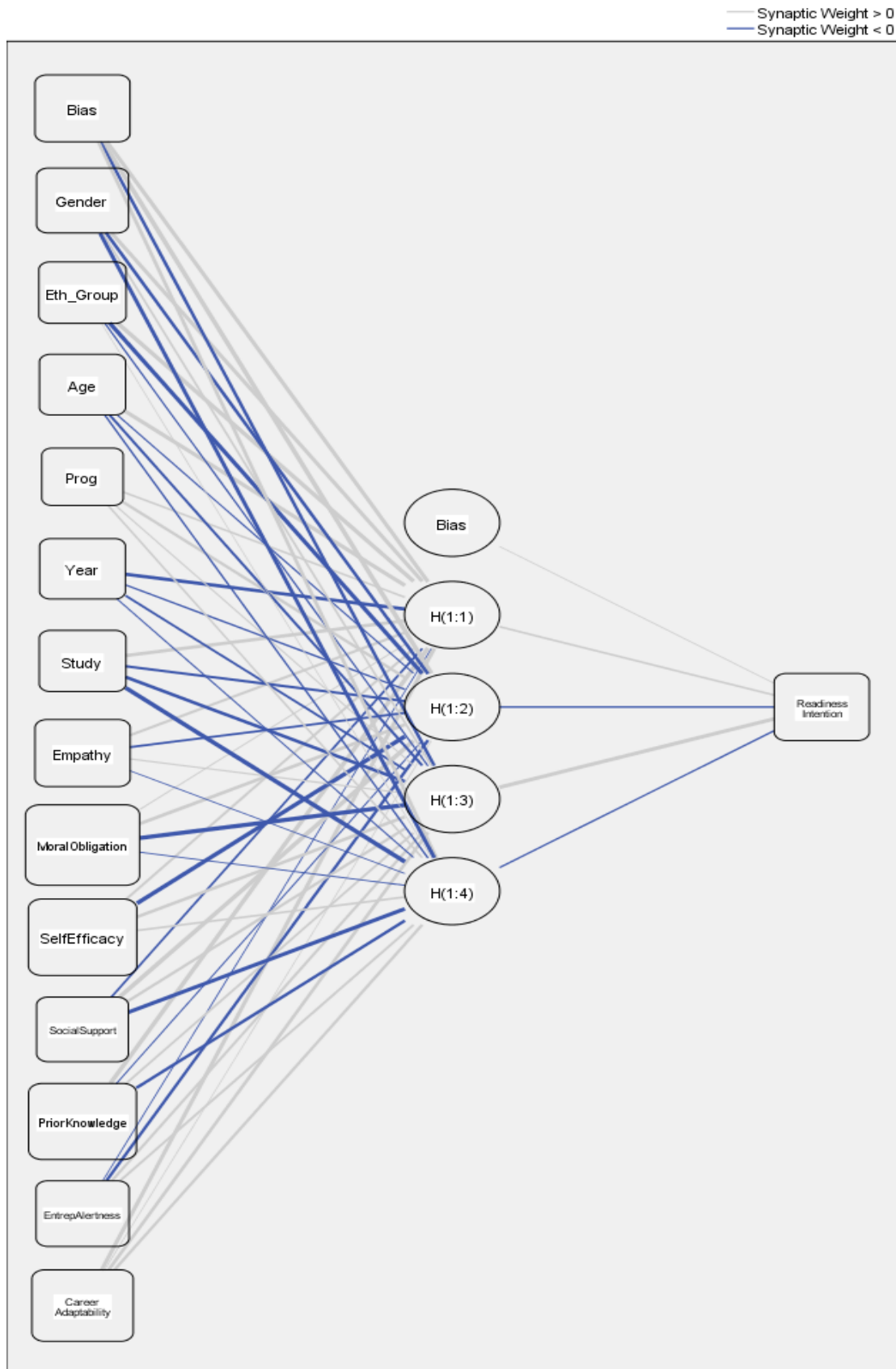
Table 5 shows the model summary of both training and testing sets. For this particular network, the sum of squares of testing sets was 25.358, with relative error equals to 0.794. On the other hand, the sum of squares for training set was 43.689, with relative error equals to 1.016. It can be said that in any network, testing set should be the reference. The relative error was 79.4 percent which was quite high. Therefore, it is firmly believe the network error can be reduced by changing the network settings, in order to improve the network performance.

TABLE V. Model Summary

<b>Training</b>	Sum of Squares Error	43.689
	Relative Error	1.016
	Stopping Rule Used	1 consecutive step(s) with no decrease in error <sup>a</sup>
	Training Time	0:00:00.04
<b>Testing</b>	Sum of Squares Error	25.358
	Relative Error	.794

Dependent Variable: Readiness Intention

a. Error computations are based on the testing sample.



Hidden layer activation function: Hyperbolic tangent

Output layer activation function: Identity

Fig. 2. Network Architecture

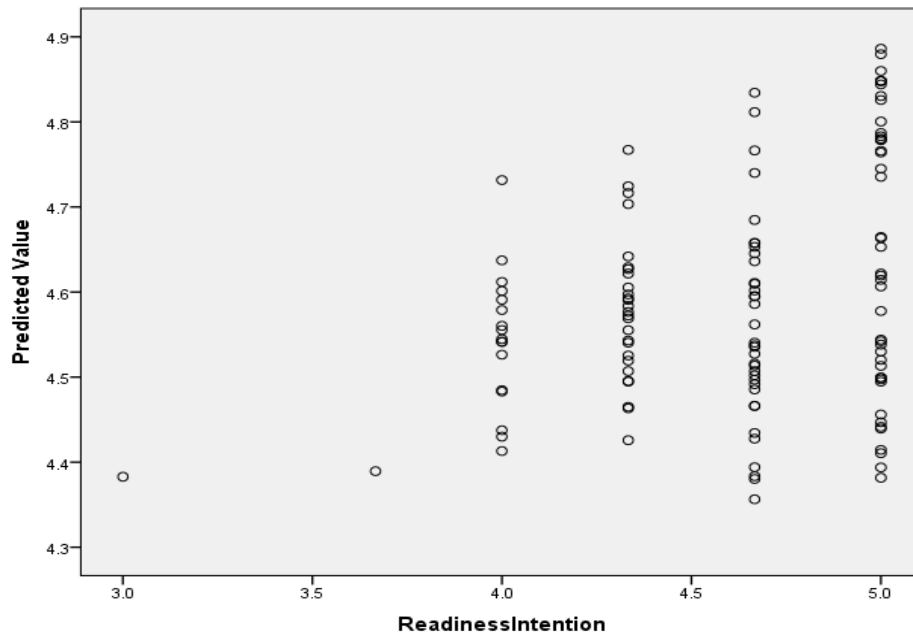


Fig.3. Standardized Residuals

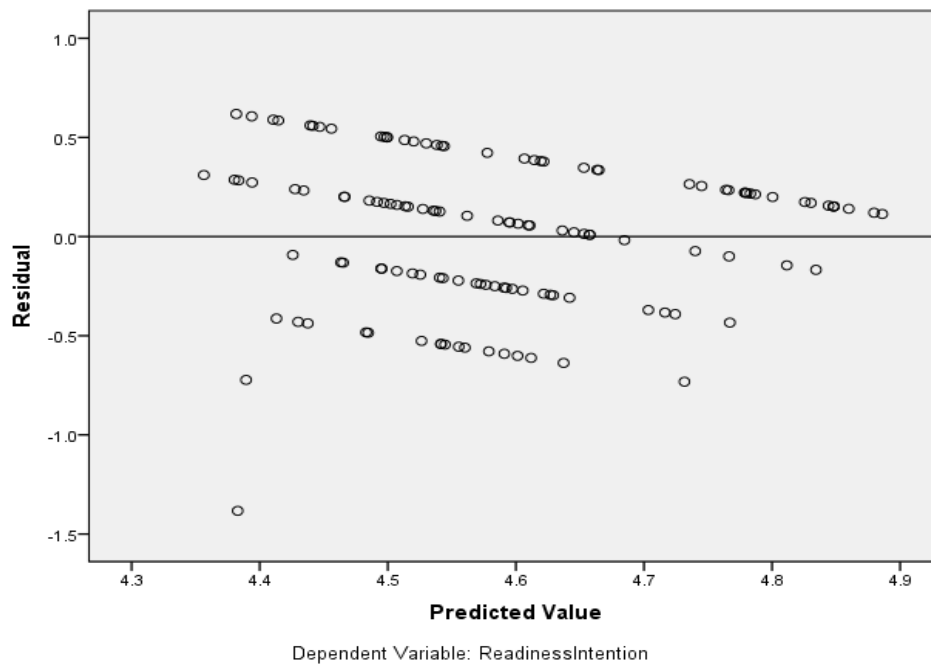


Fig.4. Distribution of Standardized Residuals



TABLE VI. Independent Variable Importance

Independent Variables	Importance	Normalized Importance
Gender	.066	41.9%
Ethnic Group	.046	29.2%
Age	.042	26.4%
Current Study Program	.022	14.0%
Current Year of Study	.040	25.2%
Field of Study	.044	27.7%
Empathy	.079	50.2%
Moral Obligation	.157	100.0%
Self Efficacy	.134	84.9%
Social Support	.065	41.4%
Prior Knowledge	.132	83.6%
Entrep Alertness	.070	44.8%
Career Adaptability	.104	66.3%

Figure 3 and Figure 4 show the standardized residuals and the distribution of standardized residuals respectively. It is found that the top five most essential factors which influence students' readiness toward social entrepreneurship and innovation are moral obligations (100%), self-efficacy (84.95), prior knowledge (83.6%), career adaptability (66.3%) and empathy (50.2%) accordingly. The parameter estimates can be referred in Table 7.

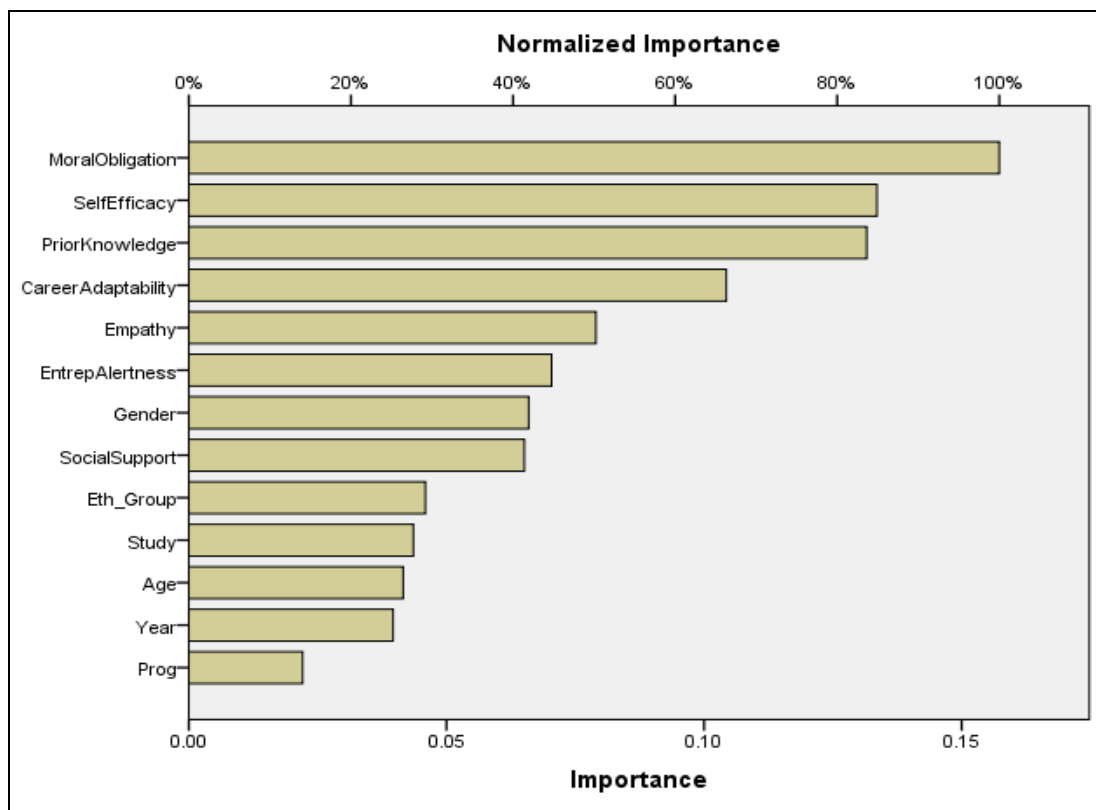


Fig.4. Normalized Importance of the Covariates

TABLE VII. Parameter Estimates

Predictor		Predicted				
		Hidden Layer 1				Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	Readiness Intention
Input Layer	(Bias)	.428	.486	-.291	.334	
	Gender	.375	-.321	.151	-.368	
	Eth_Group	.452	-.451	-.121	.004	
	Age	.447	-.104	-.236	-.129	
	Prog	.137	.289	.102	.137	
	Year	-.355	-.123	-.201	-.082	
	Study	.342	-.250	-.334	-.487	
	Empathy	.258	-.210	.106	-.027	
	Moral Obligation	.075	.341	-.491	-.061	
	Self Efficacy	.230	-.473	.327	.190	
	Social Support	-.171	.473	.273	-.451	
	Prior Knowledge	.466	-.077	.194	-.290	
	Entre Alertness	-.031	-.287	.239	.226	
Career Adaptability	.427	.010	.327	.286		
Hidden Layer 1	(Bias)					.018
	H(1:1)					.167
	H(1:2)					-.132
	H(1:3)					.433
	H(1:4)					-.122

## VI. CONCLUSION

As a conclusion, the main objective of the research has been successfully achieved. The configuration of the network adapted was 13-4-1, with hyperbolic tangent and purelin activation functions in hidden layer and output layer respectively. It is expected that optimal results can be achieved by changing the network settings, in order to improve the network performance. In the near future, several artificial neural network models will be compared in order to find the optimal model for the dataset used in this research in order to avoid the overfitting problem.

In the meanwhile, it is believed that the results are only applicable to Malaysian undergraduate students at public universities. However, this is just a preliminary studies. They context should be applied to all public universities in Malaysia. In future endeavours, this result should be extended to all private universities in Malaysia as well, before we can make a general conclusion upon undergraduate students' entrepreneurship readiness of Malaysian context.

To stay pertinent, tertiary institutions in Malaysia need to give understudies the experience of working inside complex and information rich frameworks. Through the program, understudies effectively connect with the business to do joint activities. Such communications enable understudies to shape associations with the business early, which gives them a head begin, even before they graduate.

## ACKNOWLEDGMENT

This research was supported by Research and Innovation of University Malaysia Kelantan. We thank Mohd Nazri Zakaria (Senior Lecturer and Deputy Dean of Students Development and Entrepreneurship) and Muhammad Ahslyzan Razik (Senior Lecturer) at the Faculty of Entrepreneurship and Business of University Malaysia Kelantan for sharing their pearls of wisdom during the course of this research who provided insight and expertise that greatly assisted the research. We thank our colleagues from the Faculty Business and Entrepreneurship of University Malaysia Kelantan, and Faculty of Computer and Mathematical Sciences of University Technology MARA for assistance with the particular technique and the methodology and for comments that greatly improved the manuscript

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