The Effects of the Fourth Industrial Revolution on the Career Progression of Engineers in the South African Packaging Industry

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Abstract
The manufacturing industry is facing a challenge to adapt to an ever changing business and operational environment. The fourth industrial revolution has brought a new set of challenges which requires a different approach to problem solving to remain in business. Hence, this study investigated the readiness of the case study company to operate in fourth industrial revolution. Also identified the set of competencies and career ladders to develop engineers in industry 4.0. The scope of the study was limited to the engineering department within the case study company to assess the readiness, set of engineering competencies and career ladders for engineers in industry 4.0. The study used a survey questionnaire to collect primary data from a sample of 64 employees within the engineering departments. The study used relative important index (RII) to assess the readiness of the organization to operate in industrial 4.0. The exploratory factor analysis was used to identify the set of competencies required for engineers in industry 4.0. All the items were found to have the RII more than 60% with automated manufacturing scoring a high (RII =83%) and customer driven (RII = 80%). The leadership and entrepreneurship were identified as two groups of competencies brought by industry 4.0 in the engineering field.

Keywords  
Engineering competencies, Fourth Industrial Revolution, Industry 4.0, Career ladder

1. Introduction  
The manufacturing industry is facing a challenge to acclimatize with the evolving operations brought by the introduction of the fourth industrial revolution which requires a different approach to problem solving to remain in business. The fourth industrial revolution influences the internet by digitalizing the available technologies and the ideas of quantum sciences to enhance the independence of artificial intelligence in cyber physical systems (Hwang 2016). Some of the possibilities created by the new industrial wave include the creation of smart factories, cyber-physical and the generation of big data systems (Crnjac et al. 2017). Industry 4.0 forces organizations to rethink their business strategies; processes and resource distribution. The research therefore assessed the phenomena where the career progression of engineers relates with the emerging technologies of the fourth industrial revolution. The research assessed the readiness of the case study company to operate in industry 4.0; the set of competencies and career ladders for engineer in industry 4.0. The research looked at the proverbial ceiling that engineering employees in an organization are exposed to by engaging the sample population on career progression with regards to the fourth industrial revolution. This was undertaken with the understanding of the adequate challenge that typically
organizations do not address long-term career path planning (Riley and Cudney 2015). The research outlined several sections where it looked at the literature in industry 4.0, the requirements of a manufacturing company in industry 4.0, the engineering skills and career ladders in industry 4.0 and then finally present the result and the conclusion.

1.1 Objective
The aim of the study is to assess the case study company’s readiness to industry 4.0 with the career progression competencies and career ladder in the manufacturing and packaging industry with consideration of the fourth industrial revolution by applying assessable research methodologies. The research looks at one organization in the manufacturing and packaging industry in the Republic of South Africa and then poses the following questions that are essential to drive engineering employees in the organization’s structures.
1. What are the identifiers of a fourth industrial revolution ready organization?
2. What are key competencies essential for engineers to develop into management in consideration of the fourth industrial revolution?
3. What are the typical career ladders available for engineers in the manufacturing and packaging industry?

2. Literature Reviewed
The fourth industrial revolution has been deemed as the next subsequent format of value chain organizations and management (Liu 2017). The idea of career movement in bureaucratic organizations are accelerated by properly described job ladders, scholars of the subject on the other hand distinguish that actual career trajectories can be hindered by the same formalised job ladders if incorrectly applied (Antoniu 2010). Organizations should consider the development of internal movement and opportunities, continuous growth, increased abilities and professional development (Omotayo and Ibiyinka 2014). To have a realisation of a hierarchy, organizations need to understand the competencies needed to develop an engineer into a manager in the sector of manufacturing and packaging during the industry 4.0.

2.1 The Transition during the Fourth Industrial Revolution
The Internet of Things (IoT) has increased the potential to manufacture goods while minding the environment (Roberts 2015). These developments of smart factories will fundamentally change the idea of manufacturing (Rifkin 2011). Figure 1 shows the change in which the manufacturing industry has evolved with the introduction of cyber physical systems whereby the management supporting structures can link directly with manufacturing. The fourth industrial revolution has made the nature of business to becoming a more digitalized platform which plays the pivotal role across the value chain management. This revolution moves into the utilization of engineers into management (Zhou et al. 2015).

![Figure 1: Cyber Physical Systems (CPS) (Yin et al. 2017)](image)
The new technologies and new methods of manufacturing are disrupting the norm of industrial value chains by providing quicker means to reach the customers (Schwab 2015). The new technology during industry 4.0 advances the
methods of collecting and storing big data. As figure 1 illustrates the smart factory system which incorporates the difference of the physical systems in production and digitization to meet business demands (Hozdić 2015). The success of smart factories requires big databases and analytical skills (Crnjac et al. 2017). It is suggested that the introduction of industry 4.0 increases complexity and creates uncertainty in the manufacturing industry (Schumacher et al. 2016). Nagy in 2018 introduced the model to assess the readiness of the organization to operate in industrial 4.0.

The model involves interviewing the company on their current practice and the use of interface and automation (Nagy 2018). Schumacher, Erol and Sihn created a different model to assess the readiness of the organization to operate in industrial 4.0. The model consists of nine dimensions which include implementation of industry 4.0; use of model technology to collect customer information and the use of the information technology in the organization (Schumacher et al. 2016). Whilst Mabkhot, Salah and Alkhalefah acknowledge that industry 4.0 directly impacts the traditional approach of the manufacturing process and therefore developed a framework to assess the existing production process while identifying the requirements for industry 4.0 (Mabkhot et al. 2018). The literature did not identify an agreed approach to assess the readiness of an organization to operate in industry 4.0. Hence, the current research used the work of Schumacher, Erol, and Sihn (2016), Nagy (2018) and Mabkhot, Salah, and Alkhalefah (2018) and derived the following nine points to assess the readiness of the organization to operate industry 4.0.

2.2 Career Ladders

Career ladders are a tool to retain skilled employees based on their competencies by using them as an instrument for self-assessment and verification of professional competencies (Sandehang and Hariyati 2017). The appeal of a career depends on many influences, including career opportunities, levels, direction, and social stimulus (Hall 2002). Career progression amongst professionals including scientists and engineers has been moving from a technical to a managerial approach (Petroni 2000). These professionals should have managerial capabilities, which are defined as an outline of having the attitude towards incorporating and organizing other engineering activities together with the enthusiasm to be totally accountable for the outcomes of a technical function (Ismail 2003). A career ladder is an expression used to define vertical mobility where an engineer can grow within an organization (Thompson and Schockley 2013). The transition up a career ladder has shifted post industrialism which has brought changes in the socio-economic environment. Previously, organizations viewed individuals as interchangeable items that have "similar" knowledge. The responsibility for planning and managing careers had been the sole responsibility of the organization of which it could pose a dominant influence over their employee’s careers (Baruch 2004). The industrial atmosphere has become dynamic and the responsibility has moved to the employee. Each individual is responsible for planning and managing their career. The organization bares a secondary position and is responsible for career management and evaluation (Klupáková 2013).

Engineering structures typically have three spheres for engineers to follow. Tremblay, Wils, and Proulx described these spheres as Managerial, Technical and the Hybrid (Tremblay et al. 2002). They described that the managerial route meant that the engineers were tasked with moving into careers that indicate an increasing level of managerial responsibility. The technical route is a specialized structure where the engineers become increasingly technical based where they execute a series of technical projects. The hybrid option is a combination of the other two structures where typically the engineers are involved in projects based structures and production management functions (Tremblay et al. 2002). The engineers in this case will manage and coordinate a group that comprise of technical expects. Hirsh emphasized that the use of dual career ladders for engineers as an important tool to developing skills and retaining these knowledge workers (Hirsh 2006). Wang, Courtright and Colbert indicated that the industrialization of processes in a bureaucratic context needs the advancement of career ladders which link the managerial paths and the technical path for engineers (Wang et al. 2011). The research therefore used these concepts to assess the career ladders that are available for engineers in the organization. The competencies for engineers in the organization are the building block where industry 4.0 competencies align with the career ladders.
2.3 Development of Career Ladders Using Competencies

In the development of a competency based career ladder framework for engineers, there are several spheres that should be considered. Engineering departments have the traditional dual ladder for their engineer that has been traditionally the two paths that engineers have embarked on (Rasdi et al. 2011). With the understanding of what the revolution has brought, the manufacturing and packaging sector needs to derive more strengthened forms of engineering competencies in their design for career ladders (Shehadeh and Richert 2016). The hierarchical structures mentioned under dual ladder progression are challenged and redefined by the revolution. Mark Zuckerberg mentioned that for an organization to succeed, they need to bring in great personnel who can execute on their vision (Herold 2016). The required skills development of the fourth industrial revolution has to meet the requirements of the millennial generation of employees who grew up with digital media which have altered the competencies. This evolution will revolutionise the working processes of engineers and scientists (Richert 2015). There is an agreement between the industries and academics that industry 4.0 affects the day to day functions of the engineers (Sackey and Bester 2016; Coşkun and Gençay 2019). Sackey and Bester investigated the effects of industry 4.0 on the skill requirements for industrial engineers and identified information technology, production planning; knowledge of 3D printing; data analysis, networks, and automation (Sackey and Bester 2016). In a separate publication, Plessis identified that visual management; understanding of lean tools; big data analysis; and understanding of digital factories as the skills which are important for an engineer in industry 4.0 (Plessis 2017). Prifti, Knigge, and Kienegger developed a competency model for employees in industry 4.0 with the main focus in information technology; system and engineering and identified leadership skills; modeling; business administration; decision making and big data analysis as critical skills (Prifti et al. 2017). The literature provides a different set of skills required for the engineers in industry 4.0, with big data analysis and understanding of information technology appearing more often. Bartram (2012) provided a comprehensive list of skills required by engineer in industry 4.0. Table 1 illustrates the differences as structured based on the two recent industrial revolutions that organization’s and employee competencies are required for industry 4.0 versa those of industry 3.0. The fourth industrial revolution requires a merge in technical skills and interpersonal skills in the technological sector. This requires the ability of an organization to analyse the information technology networks and data handling capabilities of the organization. Industry 4.0 also requires the ability to learn interdisciplinary environments and interpret the technology data into communication with people. A competency model consists of desired competencies for a certain task and may also include a description of a single competency as well as indicators to measure performance and outcome (Markus and Cooper-Thomas 2005).

<table>
<thead>
<tr>
<th>Third industrial revolution</th>
<th>Fourth industrial revolution</th>
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<tbody>
<tr>
<td>Knowledge of engineering sciences</td>
<td>Deciding and initiating action</td>
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<td>Engineering analysis</td>
<td>Leadership skills</td>
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<td>Engineering design</td>
<td>Business networks</td>
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<tr>
<td>Investigation</td>
<td>Emotional intelligence</td>
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<tr>
<td>Modern tool usage</td>
<td>IT and Technology affinity</td>
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<td>Individual and team work</td>
<td>Business process management</td>
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<tr>
<td>Communication</td>
<td>Presentation and communication</td>
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<tr>
<td>Ethics</td>
<td>Big Data / Data analysis</td>
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<tr>
<td>Project management and finance</td>
<td>Data security</td>
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<tr>
<td></td>
<td>Analytical skills</td>
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<td>Formulating strategies and concepts</td>
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<td>Project management</td>
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<td>Business Model Understanding</td>
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<td>Entrepreneurship</td>
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<td>Artificial intelligence</td>
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<td>System development</td>
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<td>Creating and innovation</td>
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These competencies are essential for the advancement of technology in systems like cyber-physical systems as illustrated on figure 1. Industry 4.0 has the potential to bring about potential change in manufacturing and packaging industries for countries like Germany who strive to be global leaders in the industry. These competencies are important in industries like automation, embedded systems and smart networks (Kagermann 2013). The competencies in industry
4.0 are the driving factor in changing the processes in purchasing, production, sales and maintenance by bringing forth concepts such as smart manufacturing, smart maintenance and high level automation (Prifti et al. 2017). Given the expectations of the fourth industrial revolution, organizations need to consider more quintessential forms of leadership to champion their organizations through the new era of knowledge.

3. Research Methodology

The study followed a logical approach to meet the research objectives by first reviewing the literature on the subject of industry 4.0 so as to identify how other researchers had described the concept, their approach to assessing the readiness of an organization, identification of the required skills for industry 4.0 and available career ladders for engineers in industry 4.0. The subsequent step was to derive from previous authors their frameworks which were used to assess the readiness of the case study company to operate in industry 4.0; identify the set of skills from the literature which was then used to assess the set of skills which were perceived as important for an engineer in industry 4.0. A simple criterion was followed as a mandatory inclusion in the study where the sample population should possess an engineering qualification in accordance to the Engineering Council of South Africa (ECSA). The incumbent would be referred to as an engineer in the manufacturing and packing industry by possessing a qualification of NQF level 6 (DHET 2007). The South African Qualifications Authorities (SAQA) defined NQF level 6 as an occupational certificate of a diploma and advanced certificates.

The survey questionnaire was used as a scientific method in this study based on the literature review’s research sections question (Vinodkumar and Bhasi 2009). The Likert scale was used to deduce the social responses from the sample population to obtain responses that a dependent to the views of the group (Edmondson et al. 2012). The questionnaire was divided into four sections with the first assessing the demographics of the respondents which included the educational background, their level of responsibility and their engineering functions in the organization. The main purpose of the demographic information was to determine the sample representation and the characteristic of the respondents. The second section was made up of the Likert scale which consists of nine items, and the respondents were requested to rate their responses from strongly disagree (1), disagree (2), unsure (3), agree (4) and strongly agree (5). Using Statistical Package for the Social Science (SPSS) the research had an advantage in solving differences in areas of distributions and providing better understanding of the research (Grecu 2014). The reliability of the Likert scale on the survey questionnaire was established whereby the Cronbach alpha coefficient indicated the internal consistence at which the level of the results measured in the instrument fit to the known theory (Schumacher and McMillan 2013). The value of the Cronbach alpha coefficient indicated the reliability of the resultant questionnaire as adequate as it was greater than 0.65 (Streiner and Norman 2006).

3.1 Research Demographics

The research study was conducted in a glass manufacturing and packaging company that is located in the Republic of South Africa with a manufacturing footprint across the African continent. The research was conducted in four manufacturing divisions of the organization that are located in the Gauteng province. The data was collected using a survey questionnaire which was distributed to a total of 96 engineering employees in the four divisions of the case study company. The survey collected a total of 64 responses which equated to a 67% response rate and Uma and Roger recommended the response of 30% and more as an acceptable number (Uma and Roger 2009). Figure 2 illustrates the level of responsibilities of the respondents in the organization. The respondents were spread evenly from junior levels to senior levels of the organization.  Figure 2 also indicates that 43% of the respondents are in different levels of managerial positions. These respondents formed a majority of the sample population that was gathered. It is also important to note that 40% of the respondents were in management levels whilst having a National Technical Certificate or less from a technical engineering institution. The bulk of the respondents were at none managerial positions and they formed 57% of the sampled population of respondents. These junior or none managerial level employees made up 39% of the sample population respondents who have a University National Diploma. When viewed holistically a larger number of the respondents from the sample population had a National Technical Certificate or less at a rate of 37%. This is followed by a rate of 32% of the sample population respondents that have a University National Diploma. It is worth mentioning that only 2% of the sample population of respondents had further education with a University Master’s Degree.
4. Findings

4.1 The Organization’s Readiness to the Fourth Industrial Revolution

The data collected for this section was not suitable for descriptive statistics like means and standard deviation to identify the readiness of the case study company to operate in industry 4.0. The authors opted for the weighted average called relative importance index (RII). According to Somiah and Osei-Poku these are means to help identify the areas that need improvement or the variables which are dominating by giving a set of a specific problem (Somiah and Osei-Poku 2015). The study used the formula below to calculate RII (Choudhry et al. 2014).

$$RII = \frac{\sum (QX) \times 100}{5}$$

Where Q = the number used to articulate the score for each response, strongly disagree (1), disagree (2), unsure (3), agree (4) and strongly agree (5). \(X = \frac{n}{N}\), n is the number of answers for each answer group and N is the total number of people who answered the question. Figure 3 shows the graphic presentation of the RII result and all the items had a score of more than 60%. According to Onatere-Ubrurhe when the RII is less than 60% it indicates the areas which require improvement (Onatere-Ubrurhe 2016). In the current research, the automation of manufacturing machinery had the highest score (RII=83). Customer experience was also identified as an area which receives a high level of attention from the case study company with the second high score (RII = 80%). The other seven areas had an average score of RII = 75% which shows that the company was aware and prepared to operate in industry 4.0. The results confirm the claim by Sackey and Bester suggesting that the south African manufacturing companies were gearing up to meet the requirement to operate in industry 4.0 (Sackey and Bester 2016).

The results extracted from survey questionnaires indicate that the organization is deemed to be fairly ready for industry 4.0. The organization has the technology of smart factories with which it drives the overall efficiencies and boost profit margins across the board. This new technology has snowballed throughout the different divisions of the organization to implement smart technologies. One of the characteristics that were being assessed was the skills factor of the employees. To be able to handle the intelligent systems the employees should have the capacity to find intelligent solutions in their manufacturing systems (Irani and Kamal 2014). Although the scale of skill was left to the perception of the sample population, they felt that the organization had moderate capabilities in terms of human resources. This meant that those that work at the organization have the right amount of skill to manage the organization during the fourth industrial revolution. It is then viewed from figure 3 that the organization is perhaps moving towards the fourth industrial revolution. An in depth study would indicate how far the organization is ready for industry 4.0 by investigating each characteristic of the revolution. From the results below, it shows a step towards the right direction.
4.2 The Organizations View on Engineering Competencies

The revolution is set to be dependent on the abilities of engineers and scientists (Richert 2015). The research looked at the competencies required by the engineers during industry 4.0. The fourth industrial revolution drives the engineer to becoming more business oriented in the forms of managerial structures (Zhou et al., 2015). The survey questionnaire indicated that a large number of the respondents viewed having business process management as an important competency.

Suitability for factor analysis

Like most of the statistical tests, the factor analysis requires certain assumptions to be met before applying the test (Watson 2017). One of the assumptions which needs to meet is the adequate sample size, and there is a golden rule on the sample size to perform the factor analysis. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett’s test are methods used to assess sample data's suitability to perform factor analysis (Williams et al. 2012). Both set of authors Williams, Brown, and Onsman (2012) and Choudhry, Aslam, and Hinze (2014) suggested that the KMO index should be greater than 0.5, and Bartlett’s test of sphericity should be significant at a p-value less than 0.05. The current research had the KMO index = 0.784 and Bartlett’s Test of Sphericity (Chi-Square = 578.211; df = 136; p-value = 0.000) as shown in Table 2, which indicated that the study had adequate sample size for factor analysis.

Table 2: KMO and Bartlett’s test
Factor analysis is defined as the method of measuring variables which cannot be measured using the standard meter, where also the type of concept is also called latent variable (Williams et al. 2012). There are two main types of factor analysis, which are confirmatory factor analysis and exploratory factor analysis (Roni 2014). Confirmatory factor analysis is used as a factor reduction method, and it is also used where there is a well-established theory on the concept of interest. While exploratory factor analysis is more applicable if there is not yet a well-established theory on the concept of interest (Field 2009; Williams et al. 2012; Roni 2014). The current research adopted the exploratory factor analysis on the assumption that the concept of engineering competencies in industry 4.0 is a developing concept.

There are five step by step processes provided to perform factor analysis and the steps were adopted for the current research. The process to decide on the extraction methods, extraction criteria and rotation method. The study used the principal axis factoring (PAF) and the eigen value > 1 as the criteria to extract the minimum factors (Abdi and Williams 2010). The study further used Promax rotation with the assumption that the factors associated with engineering competencies are correlated (Abdi and Williams 2010). To identify the factors to retain, the study adopted the processes suggested in (Field 2009). The process includes dealing with double loading and removing the factors which were only loading to one item. The Statistical Package for Social Sciences (SPSS) was instrumental in performing the factor analysis.

Table 3: Observed Engineering Competencies factor analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leading</td>
<td>1.088</td>
<td></td>
<td>0.953</td>
</tr>
<tr>
<td>Deciding and initiating action</td>
<td>0.951</td>
<td></td>
<td>0.780</td>
</tr>
<tr>
<td>Analytical skills</td>
<td>0.802</td>
<td></td>
<td>0.746</td>
</tr>
<tr>
<td>Project management</td>
<td>0.619</td>
<td></td>
<td>0.976</td>
</tr>
<tr>
<td>Business networks</td>
<td>0.562</td>
<td></td>
<td>0.702</td>
</tr>
<tr>
<td>Emotional intelligence</td>
<td>0.538</td>
<td></td>
<td>0.623</td>
</tr>
<tr>
<td>Systems development</td>
<td>0.526</td>
<td></td>
<td>0.807</td>
</tr>
<tr>
<td>Formulating conceptual strategies</td>
<td>0.521</td>
<td></td>
<td>0.791</td>
</tr>
<tr>
<td>IT and Technology affinity</td>
<td>0.407</td>
<td></td>
<td>0.499</td>
</tr>
<tr>
<td>Artificial intelligence</td>
<td></td>
<td>0.806</td>
<td>0.625</td>
</tr>
<tr>
<td>Business model understanding</td>
<td></td>
<td>0.717</td>
<td>0.615</td>
</tr>
<tr>
<td>Entrepreneurship</td>
<td></td>
<td>0.649</td>
<td>0.776</td>
</tr>
<tr>
<td>Data security</td>
<td></td>
<td>0.638</td>
<td>0.772</td>
</tr>
<tr>
<td>Creating and innovation</td>
<td></td>
<td>0.511</td>
<td>1.152</td>
</tr>
<tr>
<td>Business process management</td>
<td></td>
<td>0.340</td>
<td>0.360</td>
</tr>
<tr>
<td>Big data analysis</td>
<td></td>
<td>0.367</td>
<td>0.847</td>
</tr>
<tr>
<td>Variance explained (%)</td>
<td>54.967</td>
<td>8.462</td>
<td></td>
</tr>
<tr>
<td>Cumulative (%)</td>
<td>54.967</td>
<td>63.429</td>
<td></td>
</tr>
<tr>
<td>Cronbach's Alpha</td>
<td>0.896</td>
<td>0.882</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 showed the result of the factor analysis process and indicated that all the factors loaded more than 0.3, of which is the minimum loading recommended (Field 2009). The first factory (factor 1) had an average loading of 0.668 and factor 2 had an average loading of 0.575 which indicated that the items were measuring the factors well (Field 2009; Roni 2014). Factor 1 explains the total of 54.967% of the variance while factor 2 explaining the total of 8.462%, both factors explained the majority of 63.462%. The factors had the internal consistency or Cronbach's of 0.896 and 0.882. The high factor loading indicated the items were highly associated with their respective factors and Cronbach alpha greater than 0.7 indicated the items were highly associated with measuring the factors (Drost 2011).
The items also had the communality ranging from 0.360 to more than 0.9 which indicated a high level of association among items. After identifying that the factors had acceptable loading and internal consistency the subsequent step was to review the literature to identify the type of skill set which is associated with the observed skill sets.

Reviewing the literature identified that factor 1 defined the management skills necessary to operate in industry 4.0. According to the authors in the literature there are main core management competencies like project management, leading, analytical accrument, decision making and systems development that are essencial for industry 4.0 (Grzybowska and Anna 2017). Andreas Hirschi describes these skills as the social cognative career theory where the employees in industry 4.0 should have the ability to self manage (Hirschi 2017). Reviewing the literature, the elements on factor 2 identified with entrepreneurship skills. Entrepreunership thinking skills is defined as ones capability to identity opportunities in a market and finding means to maximize on these new opportunities (Grzybowska and Anna 2017). Jones and Pimdee stated that these skills were virtal for individuals operating in industry 4.0 (Jones and Pimdee 2017). Naudé stipulated that, industrialization is not the African continent’s stumbling block as it possesses most of the material and energy but the binding contraint are ideas where entreprenuership skills are critical (Naudé 2017)

4.3 The View on Engineering Career Ladders
Career paths for engineering employees take three forms as mentioned by Tremblay, Wils, and Proulx which are described as Managerial, Technical and the Hybrid (Tremblay et al. 2002). The research evaluated the level of responsibility of the respondents and the engineering career paths they had taken or intended to undertake. The research results in figure 4 indicate that the majority of the respondents viewed the organization structure to be leaning towards technical profession. The survey questionnaire posed the statement where the sample respondents would give their view on which career paths they felt were available in the organization. The results show that 52% of the respondents viewed the organization offered the technical specialist route for their engineering employees more than the other two possible structures.

From a series of questions resulting from figure 4, the research shows that engineering employees concur with the literature that their career progress is dependent from their own initiative. Their career progression within the organization comes about engaging with the organization about possible career prospects and making the effort to up skill one’s self. This result did not give a free pass to the organization of course. The respondents also indicated the need for the organization to avail itself on the table with more progressive strategies that will assist the engineering employees. These strategies involved the organization creating clear road maps that the employees would follow in working towards their futures within the organization. The organization should by all means create distinctive position...
profiles to remove any ambiguities of certain positional structures. Mostly the respondent indicated that the organization should play a role in incorporating training and development in their structures that will assist in aligning the organizations business strategies with the employee’s career growth.

5. Conclusion
Engineering employees play an integral role in this technology driven economy in contributing into the competitiveness and future potentials of the organization. The research explored the career paths that engineering employees are exposed to throughout their careers and focused on the two stakeholders affected by the fourth industrial revolution. These stakeholders are the engineering employees and the organization.

5.1 To the Engineers
The responsibility of career progression is personal in nature. Engineering employees need to ensure that they obtain the relevant competencies and requirements that will lead them to a prospective career growth by getting involved in understanding the organizations strategies and goals. Engineering employees need to comprehend that sufficient service with broader knowledge of the organization in part with the relative education are essential for career growth. The fourth industrial revolution is changing the nature of how the organizations are doing business. Engineering employees need to understand the changing technologies with regards to aligning themselves with the nature of business. Engineering employees need to assess their competencies to align with the engineering competencies of the fourth industrial revolution. Industry 4.0 requires engineering competencies that are more wide ranging than the historical technical competencies. The industry 4.0 characteristics are totally different from the third industrial revolution with the use of artificial intelligence (AI) and the internet of things (IoT).

5.2 To the Organization
The three possible structural options for engineering employees need to be visible. Information and training for each pillar needs to be relayed to the employees to understand that there is more than one option for engineering employees in the organization. The organization needs to promote a culture of career progression to remove any stagnation in the organization and promote fair competitiveness for growth. The organization should formulate career progression models that are clearly defined with their requirements that will be readily available for potential career prospects. These will be hierarchy guidelines set by the organization in regards to career planning to remove any ambiguities in relations to the different available roles in the organization. These models should identify the core competencies and set of standards of performance of each role the engineer would undertake. With regards to industry 4.0 the organization should consider aligning their structures more towards the changes being influenced by technology. Aligning with these changes would ensure the organization succeeds and increases its competitiveness in the manufacturing and packaging sector.

6. References

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7. Biographies

**Gcina Nzima** is a senior engineer in a glass manufacturing organization and holds a Baccalaureus Degree in electrical engineering from the University of Johannesburg. To date has spent seven years in the glass manufacturing and packaging industry, three in engineering sales and development and two years in the stainless steel industry in the Republic of South Africa. His work covers design and projects management of industry inspection and packaging automation machinery. The design section covers the integration of electronics and programming of industrial based systems.

**Dr Hannelie Nel** is an Academic in the Postgraduate School of Engineering Management at the University of Johannesburg. She holds a Doctorate in Engineering Management, a Master of Science Degree in Industrial Engineering and a Bachelor’s Degree in chemical Engineering. She has twenty years’ experience in both industry and academia and her work entails business and education strategy development; the design, implementation and costing of business and quality management systems; training and education; business research systems; process improvement; and gender advancement in engineering.

**Bheki Makhanya** is currently a full time doctorate student at the University of Johannesburg. He earned MPhil. in Engineering Management from the University of Johannesburg. He has about ten years’ of work experience in the rail industry and he is currently employed as a senior maintenance manager for rolling stock (wagons and locomotives).