THE DEVELOPMENT OF ESSENTIAL SKILLS MEASUREMENT FOR PRODUCTION WORKERS IN MANUFACTURING ENVIRONMENT

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A thesis submitted in fulﬁlment of the requirement for the award of the Degree of Master of Technology Management

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JUNE 2013
Continuous assessment and training are common practices used in large organizations to ensure employees are motivated and well trained which indirectly improve the overall production and product quality. Various instruments are used to evaluate skill, examining the skills levels, skills requirements, skills change and skills utilization patterns and performance of production worker. Some of the widely instruments used are UKT, TOWES, CAMERA and CAES. UKT for instance has been used in Company A for nearly five years. However, the implementation of the method incurs more cost as the result has to be evaluated in Japan and charge is imposed to individual worker who takes the test. Moreover, more time is needed to get the result available to the company’s human resources department. Hence, this research proposes an alternative instrument called Workplace Essential Skills (WES) which can produce accurate result in a shorter time, cheaper, simpler to implement and locally manage. This is descriptive analysis and case study research which employ quantitative and using questionnaire as an instrument. The research had been conducted among the production workers from various processes includes assembly, machine and inspection in Company A. Data had been analyzed using Rasch Measurement Model with Winsteps software version 3.69.0. The total population is 450 of production workers in Company A and the sample size is 181 workers. The findings from the analysis shows that the value of Cronbach Alpha is 0.90 for internal consistency of the instrument. Person reliability is 0.87 and item reliability value is 0.98, all are excellent values because approaching to one. The value of person separation is 2.59 and item separation is 7.48. Both values are acceptable because more than two. The PTMEA CORR shows positive values and it indicates all items are functioning at the same direction with the construct that being measured. The Infit and Outfit MNSQ values are within 0.5 and 1.5, and is considered within range of productive measurement. The values of ZSTD is found within ±2, it shows a normality of items in WES. Thus, WES can be as an alternative instrument to UKT for selection and new recruitment of workers and also for existing workers in Company A.
ABSTRAK

Latihan dan penilaian berterusan adalah aktiviti yang biasa dilakukan oleh organisasi besar bagi memastikan semua pekerja dilatih dengan baik dan bermotivasi. Ianya secara tidak langsung meningkatkan kualiti dan pengeluaran barangan secara keseluruhan. Pelbagai instrumen digunakan untuk menilai tahap kemahiran pekerja pengeluaran, keperluan kemahiran, pertukaran kemahiran dan corak penggunaan kemahiran dan keupayaan. Antara instrumen yang digunakan secara meluas seperti UKT, TOWES, CAMERA dan CAES. UKT sebagai contoh telah digunakan di Syarikat A selama lebih kurang lima tahun. Walaubagaimanapun, penggunaan kaedah ini melibatkan banyak kos, ianya perlu dinilai di Jepun dan bayaran dikenakan bagi pekerja yang mengambil ujian. Tambahan lagi, masa yang panjang diperlukan sebelum keputusan ujian diterima oleh jabatan sumber manusia syarikat. Kajian ini mencadangkan alternatif instrumen yang dinamakan Workplace Essential Skills (WES) yang berupaya menghasilkan keputusan ujian yang tepat dalam masa yang singkat, murah, mudah dilaksanakan dan di dalam kawalan sendiri. Ini adalah kajian deskriptif secara kajian kes menggunakan kuantitatif dan kertas soal-selidik sebagai instrument. Kajian ini melibatkan pekerja pengeluaran dari proses pemasangan, mesin dan pemeriksaan di Syarikat A. Data yang diperolehi dari Model Pengukuran Rasch telah dianalisa secara statistik dengan menggunakan perisian Winstep versi 3.69.0. Jumlah populasi adalah seramai 450 orang dan saiz sampel seramai 181 orang. Hasil dapatan menunjukkan bahawa kebolehpercayaan dalaman untuk instrumen setara dengan nilai Alpha Cronbach 0.90. Nilai Person Reliability dan nilai Item Reliability adalah 0.87 dan 0.98. Nilai ini adalah tinggi kerana menghampiri nilai satu. Nilai pemisah orang dan item adalah 2.59 dan 7.48, nilai pemisah diterima kerana melebihi dua. PTMEA CORR memberikan nilai positif dan ini menunjukkan kesemua item berfungsi pada satu arah yang sama dengan konstruk yang hendak diukur. Nilai Infit and Outfit MNSQ berada di antara julat 0.5 dan 1.5 dan dianggap produktif untuk pengukuran. Nilai ZSTD berada di antara julat ±2 dan ini menunjukkan keadaan item adalah normal. Dengan yang demikian, WES boleh digunapakai sebagai instrumen alternatif kepada UKT dalam pemilihan dan pengambilan pekerja baru dan pekerja yang sedia ada di Syarikat A.
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<td>CAES</td>
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<td>CAMERA</td>
<td>Communication and Math Employment Readiness Assessment</td>
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<td>CCLB</td>
<td>Centre for Canadian Language Benchmarks</td>
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<td>CPPI</td>
<td>Canadian Petroleum Products Institute</td>
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<td>CTHRC</td>
<td>Canadian Trucking Human Resources Council</td>
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<td>DELNI</td>
<td>Department for Employment and Learning Northern Ireland</td>
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<td>DIF</td>
<td>Differential Item Functioning</td>
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<td>DU</td>
<td>Document Use</td>
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<td>ESRP</td>
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<td>GDIF</td>
<td>Gender Differential Item Functioning</td>
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<td>HR</td>
<td>Human Resource</td>
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<td>HRSDC</td>
<td>Human Resources and Skills Development Canada</td>
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<td>IALS</td>
<td>International Adult Literacy Survey</td>
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<td>IALSS</td>
<td>International Adult Literacy Skills Survey</td>
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<td>ILSS</td>
<td>International Literacy and Skills Survey</td>
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<td>IRT</td>
<td>Item Response Theory</td>
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<td>L</td>
<td>Level</td>
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<td>LBS</td>
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<td>Literacy Link Eastern Ontario</td>
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<td>LOGIT</td>
<td>Log odds unit</td>
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<td>MCQ</td>
<td>Multiple Choice Question</td>
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<td>MNSQ</td>
<td>Mean Square</td>
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<td>MSDS</td>
<td>Material Safety Data Sheet</td>
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<td>N</td>
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<td>National Service Training Department</td>
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<td>OECD</td>
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<td>OJT</td>
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<td>PMR</td>
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<td>PTMEA CORR</td>
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<td>Pathway to Possibilities</td>
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<td>WDTF</td>
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<td>Z-Standard</td>
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<td>3M</td>
<td>Reading, Writing, Counting</td>
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<td>6S</td>
<td>(Sort, Set in order, Shine, Standardized, Sustain, Save)</td>
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CHAPTER 1

INTRODUCTION

*If you want 1 year of prosperity, grow grain.*

*If you want 10 years of prosperity, grow trees.*

*If you want 100 years of prosperity, grow people.*

- Chinese Proverb

1.0 Introduction

In this chapter, the background and motivation of the research is outlined, followed by problem statements, research questions, aim, objectives of the research, scope of the research and finally the organization of the thesis.

1.1 Background and motivation of the research

Continuous assessment and training are common practice in large and small organization to ensure employees are motivated and trained. It is also useful to improve overall production and quality. Various instruments are used to evaluate employee’s skill, assessing the skills levels, skills requirements and performance. It is commonly accepted that changes in the nature of work and the workplace in the
industrial economy are transforming of knowledge, skills and attitudes that are
needed for successful employment and work performance. These changes are due to
factors such as technology, management, innovations and competition in the global
marketplace. In United States for example, the SCANS (1991) introduced a two-part
of frameworks: workplace ‘competencies’, such as interpersonal skills, familiarity
with technology or ability to manage resources and ‘foundation skills’, including the
basic skills of reading, writing and arithmetic.

According to Steven and Anna (2001) there has been a considerable amount of
research relating measures of schooling years, qualifications or training spells to
workers’ labour market success but there has been very little assessment of the role
of more basic and numeracy skills, largely due to problems with measurement and
data availability. Competency measurement is an essential aspect in every
organization to identify the strengths and weaknesses of the human resources and is
commonly referred to as knowledge possessed and skills of the employees reinforced
with adequate experience which contributes to the success of the organizations
(Stasz, 2001). Nevertheless, the required knowledge and skills changes accordingly
over the ever changing work environments and technology requirements. Organizations ascertainment that their employees hold the necessary knowledge and
skills to endure the ever changing needs of the industry hence ensuring the survival
of the organization.

Training is one of the ways to ensure that employees gain certain skill standard
or level of knowledge required for work. Results of the test will assist organization to
plan and determine which level for training needed. Performance measurements are
typically done based on a number of successful attempts of an employee towards a
given task in a process.

According to Steven and Anna (2001), individuals without essential skills
levels of literacy and numeracy is unlikely can perform in the modern workplace.
The ability to read documents, extract information, communicate in writing and
perform basic numerical operations are clearly becoming a minimum requirement.
The requirements become a must in manual process jobs as the technology with
which employees work becomes more complex and workers are given more
autonomy to make their own decisions.

Bates and Holton (2004), discovered people with limited workplace essential
skills perceive that the work environment is less supportive. In the transfer of
learning, Bates and Holton (2004) also noted that although workplace essential skills are important to the economic success of individuals and nations, there is a substantial gap between workplace essential skills required for the workplace and those that are present in the workplace.

The manufacturing industry, like other industries that rely on skilled workers, faces many challenges in the coming decade. These include recruitment and retention of skilled workers, and high quality training to meet the industry’s evolving demands. Underlying these industry issues is the need to attract and retain workers who have strong technical and foundational skills, also known as essential skills.

The motivation to go deeper into this research derived from the researcher’s experience in electronic manufacturing background. It is important that the selection of worker is right at the recruitment level and this can then be followed by well plan training and continuous improvement process to ensure retention of a good worker, improve productivity and quality as a total. At that point, the researcher concluded that the organization needs to have a better assessment instrument that is valid and reliable to measure worker’s essential skills level. One way of doing so is by developing a new instrument as an alternative to the current one. The weakness of the current instrument is used to justify the need to develop a new instrument. The strength of a new instrument is identified based on the requirements from the organization and reviewed on literature surrounding the element of workplace essential skills.
1.2 Problem statement

The production workers’ skill in the Company A was evaluated using a proprietary Uchida-Kraepelin Test instrument and also called UKT. The instrument was originally developed in Japan and started to being applied in the organization since year 2009 until middle of year 2010. During its implementation, there had been several problems that required serious attention. First, slow processing was one of the factor because the result was only made available to the company’s human resources section after two weeks as it has to be processed in Japan and return back to the organization upon completion. As a result, human resources section has to wait for the UKT result to return before recruitment decision can be made. This would increase the probability of hiring wrong employee without the right skills. However, production cannot wait for the results to come to employ a new worker because to delay production means to delay delivery to customers and eventually jeopardizing reputation and future business opportunity. All the tests were charged per head count for every worker who undertook the test. The most disadvantage of the UKT was the organization had no control over the whole process of evaluating right from the beginning up to the end. The UKT evaluates only one element of numeracy that was insufficient for current requirement in Company A and finally, the instrument was complicated because nobody in Company A knows how the final result was computed.

It is time for Company A to look for an alternative instrument that can offer a better result to overcome the above problems. Since UKT has been introduced for quite some time in the organization, there are some requirements and competencies that need to be evaluated to ensure current requirements in Company A are catered.

This research enables a more effective instrument that can be used more faster, economical, control locally, measure more than one element and simpler. The new instrument known as Workplace Essential Skills (WES) is used for new recruitment and also for existing workers in training program to upgrade skill levels of production workers.
1.3 Research questions

Research questions are used to form a basis in deciding the direction and focus of this research. The research questions are as follows:

RQ1: Is WES a valid and reliable instrument to measure workers essential skills?

RQ2: Could WES be a better alternative instrument for UKT?

1.4 Aim and objectives of the research

The aim of the research is to propose a new instrument which is used as an input to the organization to identify the level of worker’s skill during recruitment stage. It is also served as an alternative to current instrument and the result of this research can be used by the organization as a guideline for academic prerequisites prospective which is considered essential in an entry-level for an assembly, machine and inspection worker.

The objectives of the research are described as below:

i. To test the validity and reliability of WES instrument in measuring of workplace essential skills.

ii. To propose a better new instrument as an alternative for UKT.
1.5 Scope of the research

The research had been carried out in the assembly plant of an electronic environment at Company A, which is a subsidiary of Japanese multinational company in Malaysia. Main product line-up is relay and keyboard. It also fabricates plastic injection moulding and stamping die as a secondary product. This research involved workers in assembly, machine and inspection of keyboard production in the organization because this is a labour intensive manufacturing process and depend critically on worker’s skills and knowledge. 181 workers had been selected from the organization as a respondent. The research focused on the application of UKT and WES as an instrument for measuring essential skills of workers.

1.6 Organization of the thesis

The organization of the thesis is as follows: Chapter 1 discusses about background of the research includes problem statement, research questions, objectives and scope of research. Chapter 2 presents a review previous researches and works that are related to this research. The research method is presented in Chapter 3 which discusses the research design, strategy adopted in this research and modes of data analysis. The findings of the Workplace Essential Skills (WES) assessment is analyzed and discussed in depth in Chapter 4. Finally, the conclusion and future works are discussed in Chapter 5.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed some earlier work on essential skills concept and its definitions as well as to ascertain the sub-set of skills which constitute its attributes. The other parts of the review related to researches in assessment of essential skills in manufacturing industries and also include the previous works that have been done. The discussion is finally focused on the requirement to develop an instrument to measure production worker’s essential skills at Company A.

2.2 Essential Skills in general

According to Alberta Workforce Essential Skills, AWES (2005), a consultant which provide advisory services by doing accurate needs assessments, in today’s competitive employment market, workers are expected to come into the job with the workplace Essential Skills needed to carry out workplace tasks. Today’s workplace is constantly changing as environmental and safety requirements become more stringent. Workers must take on more responsibility under lesser supervision. Changes in the workplace are constant and always have an impact on individual workers. A leaner approach to production requires workers to take on more tasks.
The ability of workers to respond to the changing workplace demands has become a point of concern as the workplace changes. However, the modern workplace requires workers to have higher Essential Skills levels in order to succeed. Therefore it is vital to include skills essential for workplace success in upgrading and training curricula.

Merrifield and Juliet (2007) on their research findings in UK recognize that the new global economy is depending on having a ‘basic platform of skills’ that allows individuals to update and adapt to change. All employers need to attract and retain skilled workers. Employers need workers to understand practices within the workplace, safety regulations, legal responsibilities and other work-related duties. Much work-related information comes in print, designed and written in ways that make it difficult for people with poor literacy skills to understand. However, people with good literacy skills will face no difficulties to read and understand. Employers face real problems when workers do not understand materials.

Another research by Powell et al. (2003) in UK found that the country needs a broad range of skills to contribute to a modern economy. The development of people’s proficiency in basic and key skills is now an important principle in government policies in Wales and UK. The basic and key skills aim to ensure that everyone possesses a wide range of Essential Skills.

Based on Stasz (2001), changes in the nature of work and the workplace in the post industrial economy transforming the knowledge, skills and attitudes of workers that are needed for successful employment and work performance. These changes are due to factors such as technology, management innovations and stiff competition in the global market place.

Gagnon et al. (2005), found that employers faced a major challenge in maintaining and generating employees’ skills to ensure that they can contribute to their organizations’ performance and competitiveness. According to Taylor and Ellers (2001) the changing demands of the workplace have been widely documented in recent years. Global competition and technological advances have led to new management strategies requiring workers to have a diversity of skills and the flexibility to adapt quickly.

Campbell (2003), stated that as technology and advanced processes change the nature of work, Canadian employers require higher levels of literacy from their
employees. Most employee posses literacy levels that are not even or of similar levels which sometimes can be below the accepted requirements.

Thompson (2001), stated that successful of company will depend not on the ability to out-produce competitors, rather it will depend on the ability to harness the power of technology and deliver top quality products and services to the valued customers on time, requiring a highly skilled workforce to do the job. This existing “skills gaps” must be closed in order to remain the number one economic power in the world.

Ford and Fisher (2001) suggested that the dominant culture and its beliefs, values and norms that have developed within relatively homogeneous workforce at the workplace is challenged by its increasing diversity. In addition, problems with the educational system along with the need for more complex cognitive skills in the workplace have led many to conclude that a skills shortage is imminent. The individual workers themselves recognized that their knowledge and skills may be inadequate for their current jobs as well as for future career goals. In some cases, the shortfall is in basic reading and math literacy skills.

The Secretary’s Commission on Achieving the Necessary Skills, SCANS (2000) formed by the U.S Department of Labour to study the kinds of competencies and skills that workers must have to succeed in today’s workplace. The focus is more on the basic skills on reading, writing, arithmetic or mathematics, listening and speaking.

The Adult Measure of Essential Skills, AMES (1997) is an assessments designed to measure the necessary workplace and educational basic skills of adults who may or may not have graduated from high school. AMES is an assessment that focuses on workplace competencies in information, resources, interpersonal, systems and technology. AMES addresses these SCANS skills of reading, writing, arithmetic/mathematics, information and resources.

The International Adult Literacy and Skills Survey, IALSS (2003) in Canada measured the proficiencies of the workforce based on four domains which are prose and document literacy, numeracy and problem solving (OECD and Statistics Canada, 2005).

From the above discussion and literatures it can be concluded that workplace Essential Skills are important and has been research quite deeply especially in advanced country. Changes in environment and competition need flexibility, fast
response and managerial innovations. One can conclude that Essential Skills are becoming more important currently and more so in the future. Based on these discussions, it could be concluded that for successful employment and work performance every employee should be able to:

a) demonstrate their competency to take on more responsibility, tasks and under less supervision

b) demonstrate their ability to respond to the changing workplace demands

c) demonstrate their higher essential skills levels in order to succeed

d) demonstrate their basic platform of skills that allows them to update and adapt to change

e) demonstrate their proficiency in basic and key skills

f) demonstrate their higher levels of literacy

2.3 Definition of Essential Skills

Based on the literature review it revealed that Essential Skills has various definitions. Sandra (2009) defined the Essential Skills based on Human Resources and Skills Development Canada, HRSDC (1994) as the skills needed for work, learning and life. It provides the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change. These Essential Skills underlie the performance of most workplace tasks. The terms Essential Skills replaces narrower terms such as Literacy or Basic Skills which refer to only some of the skills which can be considered essential in modern workplaces. Throughout this study the term Essential Skills is used instead of literacy or basic skills.
Department for Employment and Learning, Northern Ireland, DELNI (2002) defined an Essential Skills as literacy and numeracy, which require the ability to communicate by talking and listening, reading and writing; to use numeracy; and the ability to handle information.

International Adult Literacy Survey, IALS (2003) defined literacy or Essential Skills as the ability to understand and employ printed information in daily activities, at home, at work and in the community to achieve one’s goals, and to develop one’s knowledge and potential.

According to Noe (2005), Essential Skills refer to skills that are necessary for employees to successfully perform on the job and learn the content of training programs. Essential Skills include cognitive ability, reading and writing skills.

Centre for Canadian Language Benchmarks, CCLB (2005), stated that the Essential Skills framework of skill domain is expressed in terms of complexity levels and most skills are classified into five levels. It is important to note that the essence of Essential Skills is captured within these complexity ratings. Four of the nine Essential Skills are included in the Comparative Framework: Reading Text, Document Use, Writing and Oral Communication.

2.4 Summary of Essential Skills definitions

Essential Skills definitions and interpretations vary according to different literatures as discussed earlier. Table 2.1 below is the summary based on literatures and other reliable sources gathered for the purpose of this research.
Table 2.1: Summary of Essential Skills definitions

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Year</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HRSDC</td>
<td>1994</td>
<td>Essential Skills are the skills needed for work, learning and life. It provides the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change</td>
</tr>
<tr>
<td>2</td>
<td>DELNI</td>
<td>2002</td>
<td>Essential Skills as literacy and numeracy, which require the ability to communicate by talking and listening, reading and writing, to use numeracy and the ability to handle information.</td>
</tr>
<tr>
<td>3</td>
<td>IALS</td>
<td>2003</td>
<td>Essential Skills as the ability to understand and employ printed information in daily activities, at home, at work and in the community to achieve one’s goals, and to develop one’s knowledge and potential.</td>
</tr>
<tr>
<td>4</td>
<td>Raymond A. Neo</td>
<td>2005</td>
<td>Essential Skills refer to skills that are necessary for employees to successfully perform on the job and learn the content of training programs. Essential Skills include cognitive ability and reading and writing skills.</td>
</tr>
</tbody>
</table>

For the purpose of the study, the definition proposed by Human Resources and Skills Development Canada, HRSDC (1994) was used to measure the Essential Skills because it was widely used throughout industries in Canada and other countries.

2.5 The HRSDC Essential Skills elements

There are nine Essential Skills as defined by HRSDC’s (1994), and these skills are used independently to support technical skill development and other occupational skill. In other words, they provide a foundation skills and the nine Essential Skills are:

- **Reading Text**: understanding materials written in sentences or paragraphs (e.g. letters, manuals).
- **Document Use**: using and understanding labels, graphs, signs and other similar materials.
- **Numeracy**: using and understanding numbers.
- **Writing**: writing text or typing on a computer.
• **Oral Communication**: using speech to share thoughts and information.

• **Working with Others**: working with others to complete tasks.

• **Thinking**: reviewing information to make decisions.

• **Computer Use**: using computers and other technical tools (e.g. word processor, fax machine).

• **Continuous Learning**: participating in an ongoing process

This research used the first three elements of Reading Text, Document Use and Numeracy for instrument development. The selection of elements are based on the requirements from the organization based on discussion with the human resource and training section manager and also reviewed past empirical research and theories. As far as Company A is concerned, if the production worker shows a good ability with the first three elements it indicates that the remaining six elements can be taken into consideration for future continuous improvement plan.

### 2.6 Theories and Empirical Studies on the Selected Elements

Many theories of reading (e.g., Chall, 1967, 1996; Clay, 1991; Ehri, 1995; LaBerge & Samuels, 1974; Rumelhart, 1994) propose that multiple skills are learned during childhood, at home and in school, and they become coordinated into increasingly automatic reading. These theories regard skills as components to be acquired and assembled.

According to Skinner (1974), based on the behavioral theory, students learn to read by learning a series of discrete, sequenced skills and teachers applied this theory by drilling students on skills and having them complete worksheets.

According to Rumelhart (1977) and Stanovich (1989), readers construct meaning using a combination of text-based information and prior knowledge. Tompkins (2003), the fluent readers use both their prior knowledge and features in
the text simultaneously and interactively, as well as use work-identification skills and comprehension strategies simultaneously and interactively

Rosenblatt (1991), describes two purposes for reading, first is reading efferently and second is reading aesthetically. When a person reads a text efferently, he or she is only concerned with taking away pertinent information from the text: names, dates, themes, facts. Reader response theory suggests that when students read efferently rather than aesthetically, they do not learn to love reading and may not become lifelong readers (Rosenblatt, 1991). Reading modules provide the opportunity for students to read and learn aesthetically while they are reading efferently.

Vygotsky (1978, 1986) viewed reading and writing as social activities that reflected the culture and community in which people lived. According to Vygotsky (1986), language helps to organize thought, and people use language to learn as well as to communicate and share their experiences with others.

Word reading fluency is the ability to identify written words quickly and accurately (Perfetti, 1985, 1999; Stanovich, 1986). The scientific basis for the current emphasis on word reading fluency can be partially traced to automaticity theory (AT; LaBerge & Samuels, 1974; Samuels & Flor, 1997) and verbal efficiency theory (VET; Perfetti, 1985, 1999). Both theories highlight the harmful effects of inefficient skills on comprehension and maintain that if word reading demands too much attention, little remains for higher level comprehension. According to both theories, beginning readers first concentrate on word reading gradually shift attention to understand what they read. By this view, repeated practice makes word recognition automatic and frees attention for comprehension.

Consistent with AT and VET, several studies have shown that fluent word reading helps comprehension (e.g., Bell & Perfetti, 1994; Fuchs et al., 2001). Gough and Tunmer (1986) and Hoover and Gough (1990) proposed that reading consists of word recognition, with listening comprehension added on. In support of that theory, word reading fluency and listening comprehension are largely independent (Oakhill, Cain, & Bryant, 2003; Storch & Whitehurst, 2002). For instance, in early elementary school, visual and auditory analysis (e.g., phonemic awareness) determine the speed and accuracy of word reading (Pazzaglia, Cornoldi, & Tressoldi, 1993). Even so, older children can comprehend well, even when word or pseudoword reading skills are poor (Shankweiler et al., 1995; Thompson & Johnston, 2000). Adults, too, can
overcome poor word reading. For instance, college students diagnosed with dyslexia in childhood or with persistent problems in phonological processing, spelling, or rapid word reading, often comprehend adequately (Bruck, 1998; Jackson & Doellinger, 2002).

Less skilled readers low in motivation, or who do not believe in their ability to understand well, will likely compensate infrequently and comprehend poorly (Butkowsky & Willows, 1980; Johnston & Winograd, 1985).

According to Rosenblatt (1978), studied on reader response theory has revealed that good readers make connections to their reading by keeping into associations, feelings, attitudes, and ideas providing the deepest interaction between reader and text.

According to Blachowicz and Ogle (2001), active readers think as they read. They use their prior knowledge (which stems from previous experiences) and their vocabulary as well as reading strategies to help them comprehend what they are reading presently.

Students will be able to focus attention on significant aspects of the text if they can relate the information from the text to the most appropriate set of background experiences or prior knowledge, develop a coherent framework for remembering or understanding the text material, and practice cognitive skills that they will ultimately be able to use alone (Pearson, 1990).

According to Wolfe and Nevills (2004), the final step in reading is decoding automacity so that the brain’s conscious processing functions are completely available for understanding print. In addition to identifying words with sufficient speed, fluency is related to reading comprehension in two other ways: Readers must have the ability to group words into phrases that can be understood and to read accurately so they understand the text message (Barone et al., 2005).

Readers who fail to read words accurately fail to comprehend. Thus, word-level problems are potentially the most important in creating reading failures, because they lead both to word reading problems themselves and to derivative comprehension problems. For example, verbal efficiency theory (Perfetti, 1985) assumes that readers who lack efficient word identification procedures are at risk for comprehension failure.

With a focus on the theories and empirical studies discussed above one can conclude that the skills of reading and document use are about text comprehension. It
offers a comprehensive discussion of the cognitive skills involved in reading, comprehending, and making use of complex documents. Understanding such skills is important at times when printed are being used more and more extensively for work, education, and personal development.

In numeracy study, according to Reyna et al. (2001), other key factors that are correlated with numeracy, such as literacy, education, age (older people are more likely to be low in numeracy), and race or ethnicity (Hispanics tend to be lower in numeracy). Research has demonstrated that numeracy has effects on decisions that are independent of education (Reyna & Brainerd, 2007).

In another study involving 357 university clinic patients, more than half of the participants who had at least some college education answered only one or no questions correctly on the three-item general numeracy assessment developed by Schwartz, 1997; & Sheridan, 2003.

Studies have shown that physicians, (Forrow et al., 1992), medical students (Sheridan & Pignone, 2002), and well-educated laypersons, (Lipkus et al., 2001) often have difficulty performing relatively simple arithmetic calculations and comprehending numeric risk estimates, regardless of whether they are expressed numerically (e.g., as percentages) or graphically (e.g., as survival or mortality curves). Low numeracy has been associated with a number of undesirable health outcomes (DeWalt et al., 2004).

Schwartz et al. (1997), reported that women with higher scores were better able to assess the benefit of screening mammography than women with lower scores. Other research by Sheridan et al. (2003) also found that patients with higher scores were better able to interpret treatment benefits than patients with lower numeracy scores.

For example, Peters et al. (2006) make experimental predictions by discussing the deliberative and experiential processing of those high and low in numeracy. They note that participants higher in numeracy are better able to understand numbers in a deliberative fashion and are also able to draw relevant affective meaning from numbers. Participants lower in numeracy do not have the deliberative capacity to use the numbers, cannot draw affective meaning from them and, therefore, are more susceptible to irrelevant sources of information.

Based on the past research findings discussed above one can say that low numeracy is pervasive and constrains informed patient choice, reduces medication
compliance, limits access to treatments, impairs risk communication, and affects medical outcomes. Numeracy explains unique variance in medical decision making beyond that explained by such factors as education or intelligence, and cannot be reliably inferred by observable patient characteristics. Well-validated objective numeracy measures provide the most accurate assessment of basic numerical skill.

Finally, one can conclude that reading text including document use and numeracy are the basic elements that every individual must have in order to learn other skills in any area of work disciplines.

2.7 Current Essential Skills instruments

This section discussed the existing Essential Skills instruments and its elements that currently used in organisations.

2.7.1 TOWES

A Test of Workplace Essential Skills (TOWES) is an assessment instrument that uses actual workplace documents to evaluate three elements of essential skills (reading text, document use and numeracy). It was developed in 1998 by Bow Valley College to assess the literacy and numeracy skills required by workers in:

i. Reading Text: The ability to find and use information contained in text, paragraphs, letters, report, etc.

ii. Document Use: The ability to find and use information contained in charts, schematics, icons, lists, tables, signs, etc.
iii. Numeracy: The ability to find and use quantitative information like measuring, calculating, scheduling, budgeting, estimating, analyzing data, etc.

Each test in TOWES is based on an actual task carried out by a particular group of workers in Canada. Custom test design means that the parameters for each TOWES assessment are defined by the requirements of the occupation or group of occupations under consideration. It uses the mass of data collected during HRSDC’s Essential Skills Research Project (ESRP) to ensure that test content is a valid reflection of workplace reality. The tests results are delivered in a framework based on the International Adult Literacy Survey (IALS) 500 points and are consistent from one occupation to another. The summary of complexity levels are as shown in Table 2.2, 2.3 and 2.4 below.

Table 2.2: The Complexity Levels for Reading Text

<table>
<thead>
<tr>
<th>Levels</th>
<th>Scores</th>
<th>Reading Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-225</td>
<td>Most of the tasks in this level require the respondent to read relatively short text to locate a single piece of information which is identical to or synonymous with the information given in the question or directive. If plausible but incorrect information is present, it tends not to be located near the correct information.</td>
</tr>
<tr>
<td>2</td>
<td>226-275</td>
<td>Some tasks in this level require respondents to locate a single piece of information in the text. However, several distracters or plausible but incorrect pieces of information may be present or low-level inferences may be required. Other tasks require the respondent to integrate two or more pieces of information or to compare and contrast easily identifiable information based on a criterion provided in the question or directive.</td>
</tr>
<tr>
<td>3</td>
<td>276-325</td>
<td>Tasks in this level tend to require respondents to make literal or synonymous matches between the text and information given in the task or to make matches that require low-level inferences. Other tasks ask respondents to integrate information from dense or lengthy text that contains no organizational aids such as headings. Respondents may also be asked to generate a response based on information that can be easily identified in the text. Distracting information is present, but is not located near the correct information.</td>
</tr>
<tr>
<td>4</td>
<td>326-375</td>
<td>These tasks require respondents to perform multiple-feature matches and to integrate or synthesize information from complex or lengthy passages. More complex inferences are needed to perform successfully. Conditional information is frequently present in tasks at this level and must be taken into consideration by the respondent.</td>
</tr>
<tr>
<td>5</td>
<td>376-500</td>
<td>Some tasks in this level require the respondent to search for information in dense text which contains a number of plausible distracters. Others ask respondents to make high-level inferences or use specialized background knowledge. Some tasks ask respondents to contrast complex information.</td>
</tr>
</tbody>
</table>

Table 2.3: The Complexity Levels for Document Use

<table>
<thead>
<tr>
<th>Levels</th>
<th>Scores</th>
<th>Document Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-225</td>
<td>Tasks in this level tend to require the respondent either to locate a piece of information based on a literal match or to enter information from personal...</td>
</tr>
</tbody>
</table>
Knowledge onto a document. Little, if any, distracting information is present.

<table>
<thead>
<tr>
<th>Level</th>
<th>Scores</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>226-275</td>
<td>Tasks in this level are more varied than those in Level 1. Some require the respondents to match a single piece of information. However, several distracters may be present or the match may require low-level inferences. Tasks in this level may also ask the respondent to cycle through information in a document or to integrate information from various parts of a document.</td>
</tr>
<tr>
<td>3</td>
<td>276-325</td>
<td>Some tasks in this level require the respondent to integrate multiple pieces of information from one or more documents. Others ask respondents to cycle through rather complex tables or graphs which contain information that is irrelevant or inappropriate to the task.</td>
</tr>
<tr>
<td>4</td>
<td>326-375</td>
<td>Tasks in this level, like those at the previous levels, ask respondents to perform multiple-feature matches, cycle through documents and integrate information. However, they require a greater degree of inference. Many of these tasks require respondents to provide numerous responses but do not designate how many responses are needed. Conditional information is also present in the document tasks at this level and must be taken into account by the respondent.</td>
</tr>
<tr>
<td>5</td>
<td>376-500</td>
<td>Tasks in this level require the respondent to search through complex displays that contain multiple distracters, to make high-level text-based inferences and to use specialized knowledge.</td>
</tr>
</tbody>
</table>

Table 2.4: The Complexity Levels for Numeracy

<table>
<thead>
<tr>
<th>Levels</th>
<th>Scores</th>
<th>Numeracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-225</td>
<td>Tasks in this level require the respondent to show an understanding of basic numerical ideas by completing simple tasks in concrete, familiar contexts where the mathematical content is explicit with little text. Tasks consist of simple, one-step operations such as counting, sorting dates, performing simple arithmetic operations or understanding common and simple percents such as 50%.</td>
</tr>
<tr>
<td>2</td>
<td>226-275</td>
<td>Tasks in this level are fairly simple and relate to identifying and understanding basic mathematical concepts embedded in a range of familiar contexts where the mathematical content is quite explicit and visual with few distracters. Tasks tend to include one-step or two-step processes and estimations involving whole numbers, benchmark percents and fractions, interpreting simple graphical or spatial representations and performing simple measurements.</td>
</tr>
<tr>
<td>3</td>
<td>276-325</td>
<td>Tasks in this level require the respondent to demonstrate understanding of mathematical information represented in a range of different forms, such as in numbers, symbols, maps, graphs, texts and drawings. Skills required involve number and spatial sense, knowledge of mathematical patterns and relationships and the ability to interpret proportions, data and statistics embedded in relatively simple texts where there may be distracters. Tasks commonly involve undertaking a number of processes to solve problems.</td>
</tr>
<tr>
<td>4</td>
<td>326-375</td>
<td>Tasks in this level require respondents to understand a broad range of mathematical information of a more abstract nature represented in diverse ways, including texts of increasing complexity or in unfamiliar contexts. These tasks involve undertaking multiple steps to find solutions to problems and require more complex reasoning and interpretation skills, including comprehending and working with proportions and formulas or offering explanations for answers.</td>
</tr>
<tr>
<td>5</td>
<td>376-500</td>
<td>Tasks in this level require respondent to understand complex representations and abstract and formal mathematical and statistical ideas, possibly embedded in complex texts. Respondents may have to integrate multiple types of mathematical information, draw inferences or generate mathematical justification for answers.</td>
</tr>
</tbody>
</table>

TOWES is a good predictor of success in training and can pinpoint skill gaps. In the workplace, TOWES scores have been correlated to safety and accident rates. The test can be used in a variety of HR functions including recruitment, training, needs assessment, succession planning and entrance into apprenticeship.

### 2.7.2 CAMERA

The Communications and Math Employment Readiness Assessment (CAMERA) System is an integrated assessment and curriculum system for adult learners interested in developing the skills they need at work. Developed by Pathway to Possibilities (PTP) Adult Learning and Employment Programs, the CAMERA System employs real-life workplace documents and tasks to test and develop adult learners’ reading, document use, writing and numeracy skills. Drawn from HRSDC’s Essential Skills research, the documents and tasks together represent common activities in a wide variety of entry-level occupations and diverse employment settings.

CAMERA is a series of standardized tests that provide placement and diagnostic information about adult learners’ abilities to manage workplace communications and numeracy tasks. The assessments incorporate authentic workplace documents, input from employers, and Human Resources and Skills Development Canada’s (HRSDC) Essential Skills Profiles to give an accurate snapshot of learners’ skills. CAMERA tasks are selected from a wide variety of occupations and job sectors; the skills learners are asked to demonstrate are not occupationally specific but, rather, highlight the underlying Essential Skills required for success on the job. CAMERA comprises tasks that assess four skill domains: reading text, document use, numeracy and writing. The CAMERA System was created to help upgrading programs meet the needs of adults strengthening literacy and numeracy skills for work. CAMERA tests were developed to provide information to both learners and practitioners on the skills learners have and those they need to work on.

The scoring is based on HRSDC Essential Skills Levels 1, 2, 3, 4 and 5. CAMERA is designed to provide information that will help instructors prepare an
effective workforce literacy program. CAMERA also provides results that can be shared with learners so they can monitor their own progress.

2.7.3 CAES

Common Assessment of Essential Skills (CAES) tool was developed by Literacy Link Eastern Ontario (LLEO) to assist practitioners to tie Literacy and Basic Skills (LBS) Outcomes to Essential Skills. The project involved articulating the Common Assessment of Basic Skills (CABS) Online demonstrations to Essential Skills in the areas of Reading Text, Document Use and Numeracy. It provides a practical assessment tool for use with Literacy/Basic Skills candidates who can work on computers. The scoring is based on HRSDC Essential Skills Levels 1, 2, 3, 4 and 5.

2.7.4 UKT

The Uchida-Kraepelin Test (UKT) is a questionnaire modified from the Kraepelin's arithmetic test. The UKT measures the ability of takers on task performance speed and task performance accuracy. The results of the UKT provide an estimate of the individual's character. The UKT requires focused effort and attention by the subject, making this test useful for the assessment not only of character. The UKT is a simple serial addition test, which requires takers to perform calculations as fast and accurately as possible within 30 min and is commonly used for assessment of basic job performance in Japan. This was achieved using pre-printed paper containing 15 lines of random, single-digit, horizontally aligned numbers. For each minute of the test, the subject was instructed to begin a new line regardless of their position on the current line. Each line contained an excess of calculations such that the subjects were not able to finish any line for a particular minute before being prompted to move on to the start of the next minute by the examiner's prompting. This test is usually performed for repeated 15 min of work and 5 min rest cycles. UKT is designed using a simple concept of addition of two consecutive numbers as shown in Figure 2.1.
Based on Figure 2.1, the only skill required by the test is addition skill. From first row, the addition of five and seven is twelve. The result required for this test is only the last digit which is digit two and must be written under and in between these two numbers. This process is repeated with the next number which is eight. The summation of these two numbers is fourteen and the result to be written is four. Similar task is repeated until time for the test is over. A sample of test result is shown in Figure 2.2.

Score for UKT is evaluated based on the number of right answers within the given time period. The scale is used for the evaluation schema as below:

1 – Excellent
2 – Good
3 – Average
4 – Fair
5 – Poor

Those workers who fall under scale one and two are considered competent and can work independently with less supervision but for scale three need frequent guidance and supervision. Those fall under four and five they really need training and not suitable for difficult process in production line.

The summary of current assessment instruments in Table 2.5 are used as a guideline to decide which element to be adopted to develop a new assessment instrument for this research. From Table 2.5, one can conclude that, reading text,
document use and numeracy are the most elements that being assessed by TOWES, CAMERA and CAES instruments.

Table 2.5: Summary of current assessment instruments

<table>
<thead>
<tr>
<th>No</th>
<th>Assessment Instrument</th>
<th>Assessment Element</th>
</tr>
</thead>
</table>
| 1  | TOWES (Test of Workplace Essential Skills) | a) Reading Text  
b) Document Use  
c) Numeracy |
| 2  | CAMERA (Communications and Math Employment Readiness Assessment) | a) Reading Text  
b) Document Use  
c) Numeracy  
d) Writing Skills |
| 3  | CAES (Common Assessment of Essential Skills) | a) Reading Text  
b) Document Use  
c) Numeracy |
| 4  | UKT (Uchida Kraeplin Test) | a) Numeracy |

2.8 Selection of Essential Skills elements

As discussed earlier in Essential Skills definition and current assessment instruments from previous worked, most of the instruments in Table 2.5 measured at least 3 elements which are reading text, document use and numeracy. Except for CAMERA’s instrument that measured writing skills as an additional element and UKT instrument that are lacking on both reading text and document use elements.

The justification of the selection of WES elements are based on two reasons. First is based on organization’s top management decisions from managing director, directors, general managers, human resource manager and training manager. As far as Company A is concerned the three elements of Reading Text, Document Use and Numeracy are reflected the most basic requirements to focus for workers in production line. Failing the first three elements mean the workers are not competent to be recruited in production line because this is the Essential Skills minimum requirements.

Second is based on the 3 assessment instruments which are using the same elements of reading text, document use and numeracy to measure Essential Skills of
worker. Therefore the same three elements are adopted to develop a new assessment instrument for this research.

### 2.9 The complexity levels of Essential Skills

This research adapted the Essential Skills complexity levels derived from International Adult Literacy Survey (IALS) 500 points. These tasks arranged along their respective scale in terms of their difficulty for adults and the level of proficiency needed to respond correctly to each task. The procedure used in IALS to form these complexity levels is based on Item Response Theory (IRT). The IRT is a mathematical model used for estimating the probability that a particular person will respond correctly to a given task from a specified pool of tasks, Murray et al. (1998).

In an attempt to display the progression of complexity and difficulty, each proficiency scale is divided into different levels. Both the literacy and numeracy scales used five levels where Level 1 represents the lowest level of proficiency while Level 5 the highest. These levels are defined as follows: Level 1 (0-225), Level 2 (226-275), Level 3 (276-325), Level 4 (326-375) and Level 5 (376-500).

Since each level represents a progression of knowledge and skills, individuals within a particular level not only demonstrate the knowledge and skills associated with that level but the proficiencies associated with the lower levels as well. In practical terms, this means that individuals performing at 250, the middle of Level 2 on one of the literacy or numeracy scales are expected to be able to perform the average Level 1 and Level 2 task with a high degree of proficiency.

Based on the five levels of proficiency, Level 1 is regarded as the lowest and Level 5 is the highest. The organization sets Level 3 as the minimum requirement for workers to be qualified in the production line or employed during selection and recruitment phase. The level is set based on the International Adult Literacy and Skills Survey (IALSS) that measured the proficiency levels of the Canadian population in four domains: prose and document literacy, numeracy, and problem solving. The IALSS survey measured literacy and numeracy along a continuum of
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