

WORK FORCE CHARACTERISTICS: PSYCHOMETRIC PROFILING STRATEGY IN IR 4.0 ERA

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Abstract

Industry 4.0 (IR 4.0) is the implementation of Cyber Physical Systems for production. Its impact in the manufacturing sector and other technology sectors are well documented. However, the impact to human resource sector is understudied. Managing the human capital of IR 4.0 is not an easy task since it requires continuous innovation and learning dependent on people and enterprise's capabilities. Personality profiling strategy for appropriate worker screening approaches can play a vital role in the development of dynamics capabilities in Higher Learning Institution (HLI). This paper aims to present worker screening approach using systematic psychometrics profiling that promotes a climate of innovation and learning in organization, and hence facilitate businesses to match the pace of IR 4.0. The overview employs a personality profiling framework with 15 personality domains developed in an integrated and systematic tool named as i-PRO (Integrated Profiling System). The tool was developed for Universiti Teknikal Malaysia Melaka (UTeM). One of the major concepts applied was the application of Holland Individual-Environmental Congruency career interest, and adapting various established psychometrics profiling approaches, as an initiative towards adequate systematic screening strategy for recruitment, placement, succession plan, and planning the organizations' personnel development training.

Keywords: Personality profiling, higher learning institution, human capital management, IR 4.0.

INTRODUCTION

Personality profiling is a systematic process to record and analyse employees' personality traits. By understanding individual personality, the organization management team would be able to understand what may influence ones' personal and social life behaviours. The result of incompatible traits and characteristics usually affected performance (Holland, 1997).

Industry 4.0 (IR 4.0) is the implementation of Cyber Physical Systems smart manufacturing for industrial production. Managing the human capital in the era of IR 4.0 is not an easy task since it requires continuous innovation and learning dependent on people and enterprise's capabilities. In the context of Higher Learning Institution (HLI), the impact of IR 4.0 should also be visited and addressed in the benefits of its learners and workers.

Industry 4.0 and HLI Scenario

Professor Klaus Schwab, founder, and Executive Chairman of the World Economic Forum, in the WEF annual meeting held on 20-23 January 2016 has elaborated the meaning and how to respond to The Fourth Industrial Revolution as:

“..... a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global policies, from the public and private sectors to academia and civil society.”

Higher Education community too should response to challenges in a comprehensive manner. Woolf (2010) addressed some grand challenges of Artificial Intelligence (AI) in education and addressed them with five actions. 1) Virtual mentors for every learner; omnipresent support that integrates user modelling, social simulation and knowledge representation. 2) Addressing 21st century skills that assist learners with self-direction, self –assessment and teamwork. 3) Analysis of interaction data by bringing together vast amounts of data about individual learning, social contexts, learning contexts and personal interest. 4) Provide opportunities for global classrooms by increasing the interconnectedness and accessibility of classrooms worldwide. 5) Lifelong and life-wide technologies by taking learning outside of the classroom and into the learner’s life outside of school.

Professor Colin B. Grant, Vice President (International), University of Southampton, in the University Presidential forum in 2017, stated that the IR 4.0 Challenge to HLI:

“Their readiness in responding to the 4th IR, and questioned if universities are capable of managing the convergence, fluidity, power shifts, contingency and ethical issues that came along with the 4th IR”

He emphasized that investment in emerging technologies and human connectivity, building digital resilience, as well as institutional capabilities in digital governance and accountability, are key strategies for survival; and he added that, it is unclear whether the higher education communities are doing enough to adapt.

Both Woolf and Professor Grant discussed similar aspects related to individual characteristics in the context of facing challenges in the IR 4.0 era, particularly in the field of Human Learning and Intelligence (HLI). Woolf highlighted the significance of personality profiling in addressing the third challenge, which involves analysing Big Data to understand an individual's learning and working style, social context, and personal interests.

By understanding the learners and workers through personality profiling, the efforts to address Woolf's second challenge, which revolves around supporting learners in their self-directed pursuit of potential, can be greatly enhanced. This idea aligns with Professor Grant's emphasis on the need for "institutional capabilities" during the digital governance era.

In summary, both Woolf and Professor Grant's insights emphasize the importance of understanding the potential of everyone. One effective approach to achieve this understanding is through the profiling of their unique personality traits.

In any organization, including the HLI, there is a crucial requirement to assess its members (Yusoff et al., 2006) to effectively address the challenges of the IR 4.0 era. Existing literature has demonstrated that an individual's personality traits significantly impact their job performance and success. However, most of the available evidence focuses solely on individual personality traits, which falls short in delivering a comprehensive and interconnected understanding of individual personality necessary for adaptable and evolving organizations (Yusof et al., 2016).

Personality profiling strategy for screening the right workers can become an important strategic approach in the development of dynamic capabilities in organization. This paper aims to present an approach to HLI of worker and prospective student screening using systematic psychometric profiling, that will promote a climate of innovation and learning in organization, and hence facilitate businesses to match the pace of IR 4.0. Profiling is important in giving an overview to the organization management in improving and developing modules that are necessary for the future individual development programmes such as, training modules, intervention programmes, performance enhancement programmes, organizational succession planning, career development programmes (Yunus, 2004), as well as enhancing work performance and job promotion exercise. Therefore this work promotes a platform to profile individuals for the job placement. Using Individual-Environmental Congruence Theory (Holland, 1958, 1997) as the major fundamental towards matching individuals to their work environment has become the main fundamental concept of profiling approach discussed in this paper.

Consequently, there is a need to create integrated personality assessment tools to effectively screen the workforce. Neglecting this aspect may result in hiring and assigning unsuitable and unskilled workers to various positions. It is important to note that a personality type should only be deemed undesirable if it significantly conflicts with the job requirements and expectations of a specific work environment (Holland, 1999).

Individual-Environmental Congruence Theory

The relationship between personality characteristic of individual toward work performance are well established in literatures. John Holland's Individual-Environmental Congruence Theory is regarded as the most influential in the field of career counselling (Brown, 2002). Therefore, Holland's theory and the subsequent research on it were explored to determine an appropriate means of understanding the behaviour and organization members. Holland concentrated on the differences between individuals, rather than their similarities. He defines six types of individual (Realistic, Investigative, Artistic, Social, Enterprising and Conventional) and recognizes that these types will have different occupational interests.

For over fifty years, Holland's theory has emerged as a prominent force in applied psychology. It focuses on the idea of "searching" for the right person-environment fit when making vocational choices. According to Holland (1999), individuals seek situations that align with their hierarchy of adjusted orientations. Additionally, the theory emphasizes the importance of acquiring and processing environmental information for making sound vocational decisions. According to Holland (1999), individuals who

possess more information about occupational environments tend to make better choices compared to those with less information.

The core of Holland's theory, as described in a precursor article on the Vocational Preference Inventory (VPI) in 1958, revolves around projecting one's personality onto the world of work. This means that the choice of occupation reflects the individual's motivation, knowledge, personality, and abilities. Occupations are seen as representing a way of life and an environment rather than just a collection of isolated work functions or skills. For example, being a carpenter not only involves a specific status and community role but also entails adopting a unique pattern of living.

This Individual-Environmental Congruency Theory has become a fundamental concept in the development of profiling tools. Holland's Codes, known by the abbreviation RIASEC, represent the six personality types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Career Key, based on this theory, organizes and scientifically classifies careers, college majors, career clusters, and career pathways according to these personality types.

Table 1: RIASEC: The Holland's Six Types

Personality Types	Decription
Realistic (R)	They particularly value people who are practical and mechanical - who are good at working with tools, mechanical or electrical drawings, machines, or animals.
Investigative (I)	They particularly value people who are precise, scientific, and intellectual - who are good at understanding and solving science and math problems.
Artistic (A)	They particularly value people who are expressive, original, and independent - who have good artistic abilities in creative writing, drama, crafts, music, or art.
Social (S)	They particularly value people who are helpful, friendly, and trustworthy - who are good at teaching, counselling, nursing, giving information, and solving social problems.
Enterprising (E)	They particularly value people who are energetic, ambitious, and sociable - who are good at politics, leading people and selling things or ideas.
Conventional (C)	They particularly value people who are orderly, and good at following a set plan - good at working with written records and numbers in a systematic, orderly way.

Source: Holland (1997)

Table 1 is derived from Holland's theory, which proposes that individuals and work environments can be categorized into six distinct groups. Each letter in the table corresponds to one of these six groups. According to the theory, people with different personalities may be drawn to different work environments based on their preferences. While an individual may have interests and similarities with multiple of the six groups, they are likely to be primarily attracted to two or three specific areas. These two or three letters together form the person's "Holland Code," which represents their closest matches among the personality types.

For example, if someone has a code of "RES," they would most closely resemble the Realistic type, followed by some likeness to the Enterprising type, and even less resemblance to the Social type. The types that are not part of an individual's code are the ones they least resemble.

In reality, most people and jobs are a blend of two or three of the Holland interest areas. Furthermore, people tend to be more content and satisfied when there is a certain level of alignment between their personality and the characteristics of their work environment.

A Holland Code is a three-letter code that is made up of an individual's three dominant personality types out of six possible choices, according to Holland. Example of three codes are RSI, REC, IAS, ICS, ACE, AIS, SEA, SIA, EIS, ESA, CSI, CRE etc.

Each Higher Learning Institution (HLI) serves as a knowledge-promoting establishment, actively gathering diverse skilled workforce. In the challenging era of IR 4.0, the combination of varied skills has become a crucial competitive advantage for every individual in the workforce within HLI. In addition to traditional teaching methods, modern lecturers must incorporate Cyber Systems into their teaching activities, utilizing e-learning, interactive classrooms, and harnessing the potential of Big Data. These practices should be considered essential competencies for academic personnel in HLI.

Furthermore, effective HLI administrators should be well-suited to the work environment, with their working potential aligned with their personality traits. This ensures a harmonious and efficient functioning of the organization.

***i*-PRO: The Tool for Personality Profiling**

i-PRO is an Integrated Personality Profiling System designed specifically for Universiti Teknikal Malaysia Melaka (UTeM). Its primary objective is to create profiles for both the university staff and students. The tool's conceptual framework encompasses a combination of different personality trait domains, represented in Diagram 1 below.

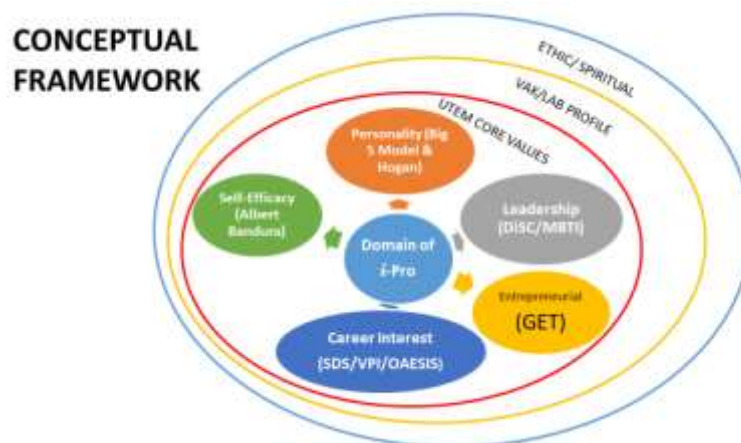


Diagram 1: i-PRO Personality Conceptual Framework

Overall, the *i*-PRO profiling system encompasses three primary domains, with an additional domain called "Ethics & Spiritual" that spans across the other three. The three main domains are as follows: 1) Personality; 2) Competency; and 3) Core Values. Each of these main domains is further divided into several sub-domains, as indicated in Table 2 below.

Table 2 - *i-PRO* Main Domains and Sub-domains

Main Domains	Personality	Competency	Core Values
Sub Domains	1. Self-Orientation 2. Career Orientation 3. Psycho-Social 4. Dominant brain 5. Self-Representation 6. Leadership	1. Entrepreneurial 2. Interpersonal 3. National Identity	1. Readiness for change 2. Resilience 3. Loyalty 4. Integrity 5. Professionalism
Domain Across	Ethics & Spiritual		

The profiling domains utilized in this system were drawn from various established instruments, including Holland Person-Environment Fit (Dawis, 1992), Hogan Personality Inventory (Hogan, 2007), Myer-Briggs Type Indicator (Myers, 1962, 1998), and the Big Five Personality (Rothmann S. & Coetzer, E.P., 2003) which served as the primary theoretical foundation. Moreover, the instrument also incorporates the organization's core values, the institution's 20-year strategic plan, and the Malaysian Education Blueprint known as Pelan Pembangunan Pendidikan Malaysia, Pendidikan Tinggi 2015 (PPPM PT). All of these elements have been integrated as fundamental components of the instrument, ensuring its alignment with the specific needs of the organization (Musa et al., 2017).

One of the domains of *i-PRO* is the Individual-Environment Congruency concept, which aims to accurately profile individuals based on their compatibility with the working environment. To address the challenges posed to the Higher Learning Institution (HLI) workforce in the era of IR 4.0, this paper will extensively examine the application of the Individual-Environment Congruency concept within *i-PRO*. The forthcoming section will detail the process of aligning an individual with their suitable working environment.

Working Environment Holland's Three-Letter Code

Referring to the Table 1, the appropriate working environment for each individual can be identified through Holland's Three-Letter code. This code serves as a concise summary that describes a specific work or occupation. For instance, if the code is ESC for a Business Manager, it signifies that business managers bear the highest resemblance to individuals in Enterprising occupations characteristic, a somewhat lesser resemblance to those in Social occupations characteristic, and an even lesser resemblance to individuals in Conventional occupations characteristic. In this manner, the codes offer a brief overview of an occupation by indicating its degree of similarity to three occupational groups.

As previously mentioned, and referenced in Table 1, the optimal working environment for everyone is denoted by Holland's Three-Letter Code. This Three-Letter Code serves as a descriptive summary of a specific work or occupation. For instance, if the code is ESC for a Business Manager, it indicates that business managers have the highest resemblance to individuals in Enterprising occupations, a slightly lesser resemblance to those in Social occupations, and an even lesser resemblance to individuals in Conventional occupations. This coding system offers a concise overview of an occupation by highlighting its level of similarity to three occupational groups.

Individuals can easily explore available occupational choices based on Holland's Three-Letter Code. Holland developed The Dictionary of Occupational Finder (DOF), which serves as a comprehensive guide listing almost all jobs in the US categorized according to the Holland's Three-Letter Code, aiding individuals in their job exploration.

Currently, there are numerous tools available online that provide extensive lists of occupations with corresponding Holland's Three-Letter Codes (RIASEC), facilitating individuals' career research. An example of such a tool is the O*Net Interest Profiler, a free online resource developed by O*Net for the U.S. Department of Labor Employment and Training Administration, which offers a vast array of careers categorized according to the Holland's Three-Letter Code.

Furthermore, most of the Higher Learning Institutions (HLI) in the US have also aligned their academic majors with the Three-Letter Code of Holland's theory. For instance, the University of Missouri in the United States follows this practice, and other examples are presented in Table 3 below. These resources and institutions play a crucial role in guiding individuals in their career exploration and decision-making processes.

Table 3: Sample of sources for Career/ Occupation and HLI Academic Major by Holland's Three-Letter Code

List Of Career/Occupation By Three-Letter Holland Code	
Career Database Resources Provider	Resources Page
Occupational Database	http://www.vista-cards.com/occupations/
O*NET	https://www.onetonline.org/find/descriptor/browse/Interests/ https://www.mynextmove.org/explore/ip
List Of HLI Academic Major By Three-Letter Holland Code	
HLI	Resources Page
Arizona State University	https://cisa.asu.edu/majorexploration/RIASEC
Indiana University	https://acd.iupui.edu/explore/choose-your-major/connect-majors-to-careers/interests/index.html
University of Missouri	http://www.wiu.edu/advising/docs/Holland_Code.pdf

In the case of UTeM, the Three-Letter Code for lecturers has already been established. This determination was made based on the required competencies for all lecturer positions to align with the organization's needs. The list of Holland's Three-Letter Codes will be used as a reference during the recruitment exercise for lecturers. An example of the Holland's Three-Letter Code for UTeM's lecturers is presented in Table 4 below.

Table 4: UTeM Lecturer Holland's Three-Letter Code by Position, Track and Specialization

Grade	VK7				DS53				DS51		
Track	T&L	R&D	Pro.		T&L	R&D	Pro.		T&L	R&D	Pro.
Eng & Ts	SIR	IRS	SRI	Eng & Ts	SIR	IRS	SRI	Eng & Ts	SIR	IRS	SRI
ICT	SIC	ICS	SCI	ICT	SIC	ICS	SCI	ICT	SIC	ICS	SCI
Mngt.	SIE	IES	SEI	Mngt.	SIE	IES	SEI	Mngt.	SIE	IES	SEI
PBPI	SIA	IAS	SAI	PBPI	SIA	IAS	SAI	PBPI	SIA	IAS	SAI

The data collected from the resources serve as a representation of individuals' suitable working or study environments based on Holland's Three-Letter Code. This information will be used in the mapping process, where it will be compared with the data of Holland's Three-Letter Code for everyone obtained from the analysis of *i-PRO*.

Person-Environment Congruency: Individual Holland's Three-Letter Code

Using *i-PRO*, individuals' responses to psychometric items in the career orientation domain will be collected and analysed. Later, *i-PRO* will generate the individual Holland's Three-Letter Code for each person based on the analysis of their responses. This code will help determine their career orientation and provide valuable insights into their potential career paths and preferences.

Table 5 – Individual's Holland's Three-Letter Code Personality Profile

R	I	A	S	E	C	Holland's Three-Letter Code
21	19	11	7	17	13	RIE

In Table 5 above, the scores are analysed to determine the individual's Holland's Three-Letter Code using *i-PRO*. For each personality type, the score is gathered, and out of the six types, the three highest scores are considered to determine the Three-Letter Code for that individual. Based on the scores in the table, the three types of personality with the highest scores are R (21), I (19), and E (17). This concludes that the Holland's Three-Letter Code for this individual is RIE.

Person-Environment Congruency: Congruency between Personality Types and Work Environment

To assess the congruency level of individuals, the Iachan Congruency Index (1984) was employed. This index was chosen due to its comprehensive measure of compatibility, specifically designed for evaluating both two and three-letter codes within the classification system proposed by Holland (1997). Moreover, the Iachan Congruency Index demonstrates a strong correlation index of $r = 0.74$, as evidenced by the research conducted by Miller and Mark in 1992 (Miller, 1998).

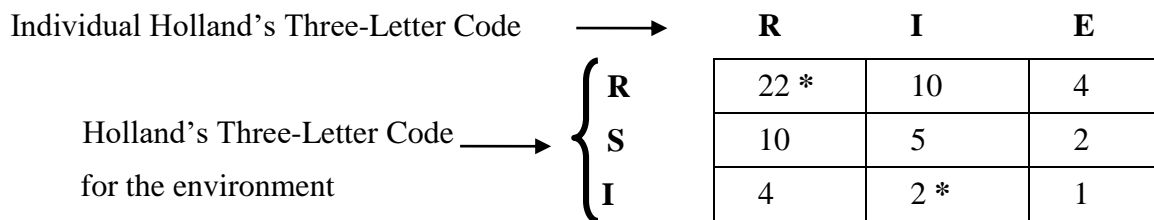
Utilizing the Iachan Congruency Index provides a precise measurement of the degree of congruency, making it well-suited for use in research endeavours. Researchers can employ this index to analyse the level of congruency between an individual's Holland's Three-Letter Code and their career orientation, which can yield valuable insights into their vocational alignment and potential job satisfaction.

As an example, let us consider a scenario where the Iachan Congruency Index is applied to analyse the congruency degree of a particular individual.

Individual Holland's Three-Letter Code profiled using *i*-PRO - R I E
 Environment Holland's Three-Letter Code (*for the environment chosen*) - R S I

According to the data provided earlier, the environmental code scores based on Holland's classification system are represented by "R, S, and I." These codes were determined by cross-referencing occupation characteristics using an online database, as detailed in Table 3 above. On the other hand, the individual's Holland's Three-Letter Code, derived from the analysis conducted by *i*-PRO, is "R, I, and E."

The congruency between these two sets of Holland's Three-Letter Codes is then examined using the Iachan Congruency Index, and the results are illustrated in diagram 2 below.



Source: Naemah (2007)

Diagram 2: Holland Congruency and Iachan Congruency Index Level

Based on Diagram 2, the two groups of scores are displayed in both horizontal and vertical orientations. The individual codes derived from the *i*-PRO analysis are positioned horizontally, progressing from left to right. Meanwhile, the environmental scores classified according to Holland's categorization are arranged vertically, descending from top to bottom.

The subsequent stage involves charting the individual and environmental codes, aiming to identify any corresponding codes between the two sets. When matching codes are found, their associated score values are determined. The first code, denoted as "R," takes precedence and holds a score of 22 points. Additionally, the "I" code is identified in both the individual and environment code sets, resulting in a matching score of 2 points. This indicates the "I" code being relevant both to the individual and the environment, following Holland's classification system. The total Iachan Congruency level score for this respondent totals 24, calculated by adding the scores of all matched codes.

Table 6 – Congruency Workers' Personality Profile

SCORE	CONGRUENCY LEVEL
26-28	Highly Congruent
20-25	Congruent
14-19	Not Congruent
13 and LESS	Highly Not Congruent

Source: Miller and Cowger (1998)

Based on the data in Table 6, the Iachan Congruency level score for this respondent is calculated as 24 ($22 + 2 = 24$), and the congruency result for this individual is determined to be "Congruent." This interpretation illustrates how the individual's level of congruency with their working or learning environment is assessed.

CONCLUSION

This systematic approach to psychometric profiling has the potential to foster an atmosphere of innovation and continuous learning within organizations, making it well-suited for navigating the challenges of the IR 4.0 era. By incorporating Holland's Individual-Environmental Congruency career interest concept and adopting diverse psychometrics profiling methods, an integrated personality framework can be created. This framework serves as an effective strategy for systematic screening in recruitment, placement, succession planning, and designing personnel development training programmes tailored for the demands of IR 4.0.

Woolf and Professor Grant's main concern was to comprehend the unique learning and working styles of diverse individuals. Their aim was to support learners and workers in their pursuit of self-directed growth to reach their fullest potential. Profiling the members of an organization holds significant importance in confronting the challenges posed by Industry 4.0, where a versatile workforce with diverse skills and competencies is essential. Therefore, the ability to provide comprehensive insights into an individual's personality traits is a crucial requirement for dynamic organizations in this era of implementing Cyber Physical Systems for production processes.

Implementing a personality profiling strategy to screen potential workers can emerge as a crucial strategic method for fostering dynamic capabilities within an organization. Utilizing tools like i-PRO or similar technologies would offer top management a comprehensive understanding of their human capital, facilitating effective management and enhancement of their workforce to meet the demands of IR 4.0.

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