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Global Journal of Engineering Education

Contents

Editorial

Our readers may be interested to know that the Australian Research Council's *Excellence in Research for Australia* (ERA) produced a ranked list of about 20,000 journals, where each was linked to one or more fields of research. Journals were also ranked into four groups, based on their alleged quality, starting with A*, A, B, and C being the lowest rank. The ranking system was not a transparent one, and it is clear that a major driver behind it was self-interest. This ERA journal list included the two international journals published by the WIETE, that is, the *Global Journal of Engineering Education* (GJEE), established in 1997, and the *World Transactions on Engineering and Technology Education* (WTE&TE), established in 2002. The allocation of journals both to fields of research and to ranking groups generated a huge academic debate due to the ambiguous terms of reference and the opaqueness of the ranking process.

The ERA journal ranking scheme invited public input, and the WIETE contributed to this debate by submitting its opinion on the procedural deficiencies of the scheme. So much was the discontent in the sector that on 30 May 2011, the Minister for Innovation, Industry, Science and Research, Senator Kim Carr, released a ministerial statement in which he formally announced *improvements* to the ERA. One of them was the removal of the prescriptive and highly divisive ranks from the journal quality indicator. Instead, the Minister has come up with another measure of the quality of scientific journals by *The introduction of a journal quality profile, showing the most frequently published journals for each unit of evaluation.*

I wonder how the ARC and ERA will convert this rather vague statement into a democratic and representative system of evaluation of scientific journals. The positive side of this affair, however, is that the academics, who are in the centre of the ERA exercise, expressed their views and concerns about the secretive way the matter had been handled by the ARC. And the moral of the story is that academics should always be alert to bureaucratic interventions in academic affairs. Academics must always be free to exercise their rights to contribute to debates, and express their views and concerns on burning and critical issues concerning their work. I hope that our readers will come up with articles on the matter of quality in engineering and technology education, and how this process may be instituted so that relevant assessments of quality outlets may be made.

Another important issue that concerns our operation is the organisation of the *3rd WIETE Annual Conference on Engineering and Technology Education* under the theme of *Networking in Engineering and Technology Education*. The Conference will be held between 6 and 10 February 2012 at Seri Place Hotel, Pattaya, Thailand, and a Conference announcement, including a call for papers, is available from the WIETE Web site.

In the meantime, we are delighted and honoured to be able to release this issue of the Global Journal of Engineering Education (GJEE), marked Vol.13, No.2. It features six peer-refereed original articles from authors representing six countries: Australia, Canada, Cuba, Taiwan, Thailand and the USA. As originally planned, this first full annual volume will comprise three issues. A call for articles is made in the Journal's site on the Internet.

On behalf of our readers, the entire editorial team, and indeed myself, I wish to thank the authors of the articles for their willingness to publish their articles in this journal. I would also like to express my sincere gratitude to Ms Dianne Q. Nguyen and Ms Krystyna Wareing for their assistance in the preparation of this issue for publication.

Zenon J. Pudlowski

Global Journal of Engineering Education

Evaluating the English-learning of engineering students using the Grey S-P chart: a Facebook case study in Taiwan

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ABSTRACT: The aim of this article was to evaluate the English-learning of engineering students by using the Grey Student-Problem chart (GSP chart). The research was conducted with 37 freshman engineering students in a private university in central Taiwan using Facebook wall posts to make English sentences, and the GSP chart to evaluate the engineering students' English performance. The two vocabulary tests, based on the General Service List (GSL), with ten questions were given as the pre-test and post-test. To uncover the usefulness of learning vocabulary on Facebook, the vocabulary tests' scores were compared using the GSP chart. The findings suggest Taiwanese engineering students performed better on the English vocabulary examination after practising making English sentences on Facebook. The Web-based tool provides a ubiquitous English-learning environment for engineering students, and is believed to increase students' English vocabulary acquisition, as well.

Keywords: Grey Student-Problem chart, Facebook, General Service List, ubiquitous English-learning, English vocabulary acquisition

INTRODUCTION

English has become more important in Taiwan given the trend of globalisation and internationalisation. Therefore, the Ministry of Education (MOE) in Taiwan put a lot of effort into improving students' English skills [1-3]. The MOE also noticed that university students' English performance is worse than the younger generation [4]. Hence, this article aims to apply Facebook to English-learning among freshman engineering students at a private university in central Taiwan. It is hoped that through making English sentences on Facebook, the engineering students could not only share their ideas, but also increase their English vocabulary acquisition. Also, with this ubiquitous English-learning environment, the teacher and students can share their Facebook posts no matter the time or location [5]. Students were divided into six groups, and needed to work within their groups to finish the assignment. Through the collaborative learning experience, the team members were expected to generate more ideas and reduce the stress of doing the task [6][7]. Moreover, students today are digital natives, while teachers are digital immigrants [8]. If teachers could teach students the way they prefer to learn, it may help improve attainment [8][9]. This project was, therefore, developed to focus on:

1. How engineering students' engagement with Facebook influenced their English vocabulary learning.
2. Evaluation of engineering students' English progress in a quantitative way.

METHOD

Facebook as a Learning Platform

Since early 2004, the invention of the Social Networking Site (SNS), Facebook, has influenced learning styles in higher education [7][9]. According to Kwong, the general concept of Facebook was to increase social networking and interactions among Harvard freshman students, and later in 2005, Facebook was opened up to the people outside the university network, so that everyone in the world could use it to frame their profiles, share photos, announce upcoming events, join interesting groups, etc [10]. Compared with other learning platforms, like Moodle, which is more teacher-centred, Facebook has become a popular platform for students to post, share or provide feedback with just one click [11][12].

Some have reservations that this kind of social networking platform distracts students from their academic studies, and, in any event, the question is asked: is it useful in the formal classroom setting [12]? However, if teachers could utilise this convenient and user-friendly Web tool, design suitable curricula, and evaluate students' learning in an objective

way, students may increase their motivation for class participation [13]. For instance, both the instructor and the students could check the bulletin board, send e-mails or messages and share video clips on Facebook.

Undoubtedly, this digital natives generation seems to be more interested in the Web 2.0 environment (i.e. blogs, You Tube, Twitter) than the traditional classroom. Therefore, teachers need to consider modifying their teaching methods not only to fit students' pace of learning, but also to create a student-centred learning environment [14]. To date, the communication between students and teachers has been done via e-mail, but this seems to be more private and other students do not share ideas with their peers. In order to increase the interactions between instructor-student or student-student, educators may want to apply a new technology in teaching, and to set up their own Facebook sites to keep in touch with the students in a ubiquitous English-learning environment, where students can browse the English-related articles provided by the teacher on the Internet and the instructor can reply in public [5].

GSP Establishment Through Grey Relational Analysis

This section gives a brief introduction to establishing the GSP chart through Grey Relational Analysis (GRA) [15-21].

1. Raw data establishment:

$$x_0 = (x_0(1), x_0(2), \cdots, x_0(k), \cdots, x_0(m)); k = 1,2,...,m \quad \text{Reference Vector} \tag{1}$$

$$\left.\begin{array}{l} x_1 = (x_1(1), x_1(2), \cdots, x_1(k), \cdots, x_1(m)) \\ x_2 = (x_2(1), x_2(2), \cdots, x_2(k), \cdots, x_2(m)) \\ \quad \vdots \\ x_i = (x_i(1), x_i(2), \cdots, x_i(k), \cdots, x_i(m)) \\ \quad \vdots \\ x_n = (x_n(1), x_n(2), \cdots, x_n(k), \cdots, x_n(m)) \\ i = 1,2,...,n \end{array}\right\} \quad \text{Comparative Vector} \tag{2}$$

2. Generation of the grey relation: try to standardise the data by using three methods – larger-the-better, smaller-the-better, and nominal-the-better. In this article, the method of larger-the-better is used, and it is shown as follows:

$$x_i^*(k) = \frac{x_i(k) - \min\limits_i x_i(k)}{\max\limits_i x_i(k) - \min\limits_i x_i(k)} \tag{3}$$

where $\max\limits_i x_i(k)$ means the maximum number in j and $\min\limits_i x_i(k)$ means the minimum number in j.

3. Calculation of the grey relational: apply Nagai's equation to calculate the grey relation [16-18]. Among them, the reference vector of the local GRA is X_0, and the comparative vector is X_j. When Γ_{0i} is close to 1, it means that X_0 and X_j are highly correlated. The equation is shown as follows:

$$\Gamma_{0i} = \Gamma(x_o(k), x_i(k)) = \frac{\overline{\Delta}_{\max} - \overline{\Delta}_{0i}}{\overline{\Delta}_{\max} - \overline{\Delta}_{\min}}$$

$$\overline{\Delta}_{0i} = \left\| x_{0i} \right\|_\rho = \left(\sum_{k=1}^{n} [\Delta_{0i}(k)]^\rho \right)^{\frac{1}{\rho}} \tag{4}$$

where $\overline{\Delta}_{\max}$ and $\overline{\Delta}_{\min}$ represent $\overline{\Delta}_{0i}$'s maximum and minimum, respectively.

GSP Chart Theory

The Grey Student-Problem chart (GSP chart) originated from the Student-Problem chart (SP chart), which was proposed by Takahiro Sato in the 1970s. Based on the SP chart, it is possible to analyse the data in a quantitative way, and to diagnose students' learning through the calculation of the Problem Caution Index (CP) and Student Caution Index (CS) [22]. However, the SP chart only codes the data as either 0 (incorrect answer) or 1 (correct answer), but it fails to reflect the actual values in the scoring [21]. Therefore, Nagai Masatake combined GRA and the S-P chart to establish the GSP chart, which allows for a more specific analysis of the data [16]. Compared to the SP chart, the GSP chart can deal with uncertain, multivariate, and discrete data through mathematic equations, and then present the results as figures [16][19-21]. The GSP also combines the Rasch model to create measures, and the equation is shown as follows [19-21][23].

$$\Pr(X_i = 1 | \theta) = c_i + \frac{1 - c_i}{1 + \exp[-1.7 a_i(\theta - b_i)]} \tag{5}$$

where θ represents test-takers' abilities; a_i is the item discrimination parameter; b_i is the item difficulty parameter; c_i is the item guessing parameter. $\Pr(X_i = 1|\theta)$ is the probability of a test taker (ability $= \theta$) to answer the question correctly [21]. The item difficulty parameter, points on the theta continuum, corresponds to a 50% probability of endorsing the item [21].

RESEARCH DESIGN

Participants

A total of 37 freshman engineering students in the Freshman English course took the English vocabulary pre-test and post-test (based on the GSL words). The GSL is a set of 2,000 words selected (based on the frequency of usage) to be of the greatest *general service* to English learners. The engineering students' ages ranged from 18 to 20, and most of them have learned English for at least six years before taking part in this research. Their English level is defined as CEF A2, after taking the unified placement test (Standford test) at the beginning of the academic year.

Data Collection and Analysis

All of the engineering students in the same Freshman English course took the vocabulary pre-test at the beginning of the course. As for the Facebook assignment, the instructor had to create her own profile page on Facebook first, and the group page for the engineering class. Then, the engineering students were asked to register on Facebook and join the group Engineering B, which was administrated by the instructor. Next, the engineering students were divided into six groups, and each group was assigned with a 42-word English vocabulary (based on the GSL), and each group had to upload pictures related to the meaning of the assigned words to Facebook, and make a related English sentence below each picture every week. At this stage, students could choose to take their own pictures or get the pictures on-line. The other groups were encouraged to give comments on each picture and sentence on Facebook, or at least they needed to choose *like or dislike* on Facebook. After six weeks' practise, the participants were asked to take the vocabulary post-test to check their English vocabulary progress. The examples of Facebook wall posts are shown in Figure 1 and Figure 2.

Figure 1: Group work on Facebook (Example I).

Figure 2: Group work on Facebook (Example II).

The students in this research were asked to take the pre-test and post-test vocabulary tests in class to identify their proficiency levels, and check if any differences could be found between the two tests. Moreover, their test scores were collected and analysed using the GSP chart.

Establishing the GSP Chart

By coding the examination results of the pre-test and post-test into the S-P chart, and then applying MATLAB 7.0 to analyse the data [16][19][20], the GSP figures are shown as Figure 3 and Figure 4.

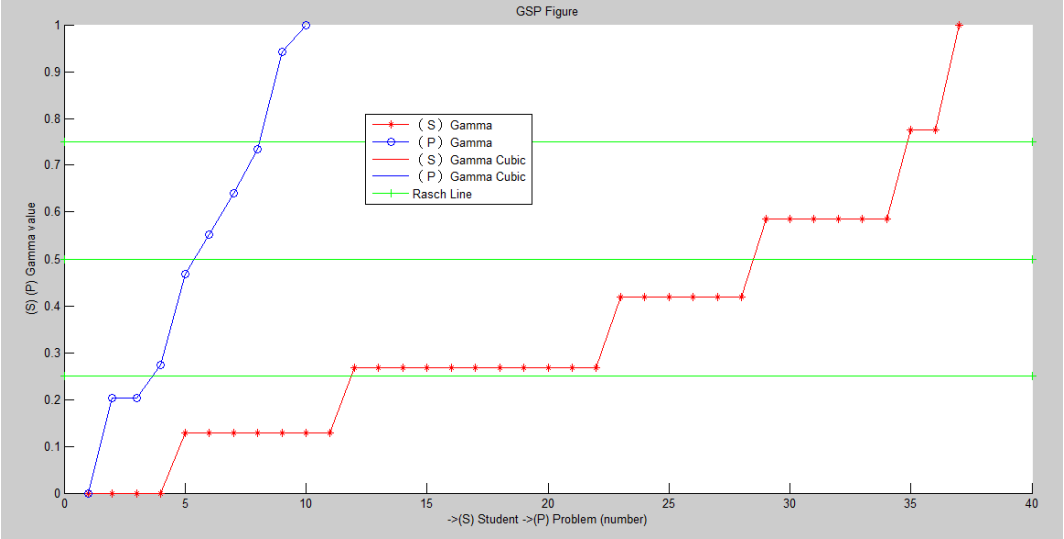

Figure 3: The GSP of English vocabulary - pre-test.

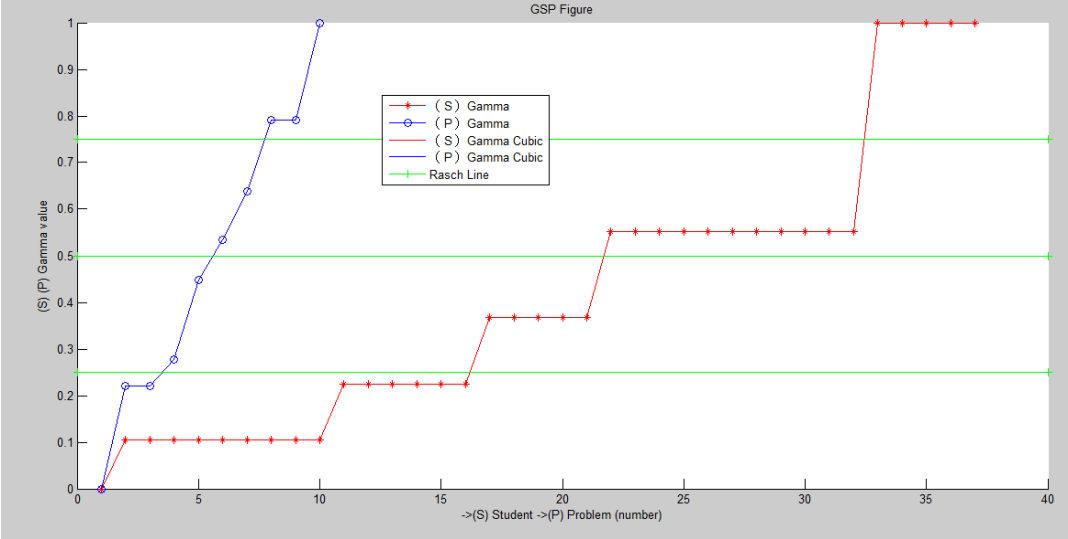

Figure 4: The GSP of English vocabulary - post-test.

ANALYSIS: RESULTS AND DISCUSSION

Based on the *Gamma* value in Figure 3 and Figure 4, engineering freshman students can be clustered into four groups according to their abilities, and the results are shown in Table 1 [19][20][23].

Table 1: Clustered group.

Group	Examination performance	*Gamma* value
A	High	$Gamma \geq 0.75$
B	Intermediate-high	$0.75 \geq Gamma \geq 0.5$
C	Intermediate	$0.5 \geq Gamma \geq 0.25$
D	Low	$0.25 \geq Gamma$

Obviously, there are two types of students whose English ability is above 0.5 in the post-test than in the pre-test. That is, engineering students benefit from learning vocabulary on Facebook, and the progress is shown in Figure 3 and

Figure 4. Moreover, the slope in Figure 4 is greater than Figure 3, which can be interpreted as having a more discriminating *ai* , and this means most of the engineering students performed better in the post-test. However, this Web-based learning may not be ideal for low-level students since there are still 16 students whose abilities (*Gamma* value) are below 0.25 in the post-test. This is probably because the low level students are easily distracted by other games, pop-out ads or interesting video clips while surfing the Internet. Or they may feel isolated, frustrated and anxious while doing the on-line assignment [12]. Therefore, it is suggested that the teacher could supervise these students and provide clearer instructions to let them understand the advantages of on-line learning.

CONCLUSIONS

The results of the study indicated that most engineering students improved their English vocabulary, after sharing their posts on Facebook. Some students even corrected others' errors, and gave feedback on Facebook. Students tended to provide and share more ideas on this social networking site than in the traditional English taught classroom. In the classroom, when the instructor asked questions, few students were willing to answer. However, when there were new posts on Facebook, there were comments given under the posts right away. Most students replied on Facebook, and showed that they enjoyed the flexibility of the on-line learning environment, and more innovative ideas were simulated, which also facilitated learning [12]. According to Maranto, Facebook emphasises categories and aspects of popular culture that teenagers find important [24]. Hence, teachers could combine Facebook with English learning to increase students' learning motivation. However, teachers need to provide clear instructions to ensure the academic usage of Facebook instead of the social one.

The study used the GSP chart to analyse engineering students' performances in a quantitative way. Students' abilities were clustered as shown clearly in the figures, which are better than the original SP chart. With the GSP chart, uncertain, multivariate, and discrete data could be conducted [16]. Also, it is easier for teachers to check individual students' progress using the figures and, then, teachers could not only provide remedial instructions, but also adjust the curriculum design to suit the engineering students' needs [25][26].

Finally, there were only 37 engineering students involved in this research, and it is suggested that future research could use a larger pool of participants. This stude only used quantitative measures to evaluate the data, but it could be better, if there was a qualitative approach, such as interviews or questionnaires to examine the students' proficiency levels.

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BIOGRAPHY

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Global Journal of Engineering Education

Maintaining the corporate asset

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ABSTRACT: The essence of maintenance, in an engineering sense, has been described as *maintaining the value of assets*, meaning, usually, the physical, hardware assets. But in a more general, corporate sense, it can be defined as *maintaining the value of* all *assets*; for example, software and intangibles such as quality and culture, in order to be better than competitors and keep out of trouble with government departments. All those intangibles can open the engineering student's outlook to issues not generally covered in the class-room lecture or tutorial series, so now one can look at some of them, and one issue in particular.

Keywords: Assets, values, personality

INTRODUCTION

This article has been inspired by recognising that physical, tangible, hardware is only part of the overall asset structure and its management. If one takes a complete, company-wide view, there are many more aspects of maintenance, which should get attention in addition to keeping the hardware alive and funds adequate. One aspect, often neglected, is due to the fact that the world outside a company and its employees does not stand still, time marches on, and in order to succeed in upholding an asset's present value management must include not only today's activities but also some measures of updating. And, another aspect is the perception held of the company, externally by that world outside, and internally by the employees, which is affected by what we term the company's *personality*.

Managing a company involves a broad range of occupations, several of whom become involved in maintaining the value of the company's assets, and as examples one can name engineers and accountants. The engineer concentrates on physical, tangible assets, the accountant on their value. But, if we look into those activities, there is a question: what we include under the title of *assets*? Apart from the physical objects and their monetary value, there are other assets, which are intangible, particularly one, to be discussed here.

We will now explore how companies and employees seek, and use, ways to maintain their position, and maintain their *personality*.

WHAT IS MY VALUE TO MYSELF?

First of all, let us consider assets at a personal level, the individual value of oneself, of a person, an employee, an individual, at some level in an organisation, to that person's self. Most of us know some who regard *themselves* as *Number One*, people who want good in life for themselves only, with no thought of what is good for others, no-one else counts. Their personal-asset-value is enormous. Perhaps that is a selfish attitude, but it is quite common, although not many might admit to such a personal philosophy.

However, might one reasonably argue that regarding ones-self as *Number One* is not unreasonably selfish? Indeed, one may well argue in favour of such an attitude, particularly in the workplace, because few around us in our workplaces are prepared to stand up and support another, you and me - unless there is some potential for reward, in which case the person giving support to another would be currying favour in some way. Putting that bluntly in one direction, it is very easy to support the boss, showing he (or she) is *Number One*, in the expectation that the boss will reward the person

behaving as a sycophant - that is, a person who supports the boss as *Number One* is usually aiming for the boss to regard him (or her) in some sort of lower *number-one-ish* category.

The result of this reasoning is: those who follow that implicitly are obeying the law of the (corporate) *jungle*. However, it is a rather radical (and cynical?) point of view, contrary to much we are taught, or gather, as we grow up. Many institutions of our society teach us to help each other, and to expect we will receive help from others, in line with the maxim *do unto others as others would do unto you* (to which the comic strip character Hagar-the-Horrible added *but do it first*, suggesting he had negative expectations of others' behaviour). The argument in favour of this radical attitude has been presented by a very few writers, such as Pedler and Boydell [1], who have expressed it quite plainly, and Crosby [2] and Marsh [3], who put it somewhat more obliquely.

So, that is a brief coverage of what is meant by an individual's use of *Number One*. It is self-promoting, makes use of others, and becomes self-protecting.

THE PERSONALITY OF A PERSON

The word used to describe what we see of each other, and how we interpret all that, is *personality*. Used correctly, this refers to the *whole person*, but unfortunately we find it used (that is, *mis*-used) very often in a segmented fashion, looking only at a part of a person. For example, we who are not psychologists and, therefore, less definition-precise may say of a person who is a social success that *he has a lot of personality*, or we may classify a person by some particularly noticeable characteristic (such as having a shy, or eloquent, personality). Worst of all, the loosest use of the word is the description of someone in the entertainment industry as *a personality*.

The search for a precise layman's definition, therefore, presents great difficulty. One prominent psychology writer, G. Allport, is reported to have found fifty definitions of the word [4]. Although he grouped them into five areas, each distinctly labelled, he found no common statement, and produced his own definition:

> *Personality is the dynamic organisation within the individual of those psychological systems which determine his unique adjustments to his environment* [4].

The origin of the word is interesting: it comes from the Latin *per sonare*, *to speak through*, and was used in ancient Rome because actors wore masks to show the role they were acting, and they spoke the part through the mask. Observation of those with whom we work suggests very strongly that most of us (if not all, to be honest) take up roles in our dealings with others, creating a *mask* through which we present ourselves as whatever *person*, we want to appear to be at any one time. Contrawise, the perception taken by those around may be different from what is intended, if the acting is not adequately convincing. (As an illustration of that: in one period of employment this author was astonished to find the trades personnel called him *Captain Bligh*, the perception overcame the intended presentation.)

So now we come to the concept of a *corporate personality*.

THE CORPORATE PERSON

Now to an aspect of corporate management probably unknown by most engineering students, but sufficiently important for students to be made aware of it: it is the personality factor in corporate existence.

A company, a corporation, is generally regarded as a *thing*, something which exists, but only in some ephemeral manner. However, from another point of view, a company, an employing corporation, has some of the qualities of a *person*, and hence, to the company it can, in itself, desire to be *Number One*. This is not as well concealed as an individual's *Number One* attitude. Corporations generally compete vigorously to be among the top of their product or service group, not quite by *the law of the jungle*, kill or be killed, but something approaching it, certainly survival of the fittest. Companies are only restrained from extreme aggression by the bounds of our legal system, by a generally accepted belief that any firm, which gets control of more than one third of a market is ripe for attack, and by our government's dislike of monopolies (unless they are run by the government, of course). These behavioural characteristics fit with the concept of a corporation being *a person*, having a primary interest in self-preservation.

The above argument has reached the stage where some, perhaps many, will ask: how come we regard a corporation as *a person*? If we are going to develop this theme we need support for the concept. We may have heard the expression used, but how did it come about?

It is interesting to look back at the history of how *a corporation* became recognised as *a person*, and it appears to have happened out of a relatively minor taxation case, and curiously indirectly from that. This case, and its many deep ramifications, has been reviewed by Hartmann, used here as reference for the *corporate person* concept [5]. Before that case occurred, there were attempts in America, in the mid-1850s, to bring in such a concept, and in fact Abraham Lincoln used it, when representing a railroad company, but was unsuccessful.

Then in 1869, the United States brought in the Fourteenth Amendment, really intending it to ensure the now-emancipated slaves received full access to all legal due process. But the wording began with *All persons*, and ended with *the equal protection of the laws*, so, in the mid-1860s, when the Santa Clara County in California sued the Southern Pacific Railroad Company for refusing to pay taxes, the Company used the Fourteenth Amendment as part of their defence, claiming the Company as a person, deserved that equal protection.

One quaint feature of the defence was the distinction between two strips of land along the railroad. On one side of the case was the County, which charged taxes on the land occupied by the railroad itself, plus the land on which the surrounding fences stood. On the other side was the Company, which agreed they owned the land under the tracks, but claimed that they did not own the fences and, therefore, should not have to pay tax on that land. They were ultimately successful, apparently, because the County did in fact own the fences.

Another feature, even quainter, is the general belief that the Supreme Court actually decided, in the case of Santa Clara County *versus* Southern Pacific Railroad Company, that corporations were persons under the Fourteenth Amendment, but Hartmann's research showed that was written in as a head-note by a court reporter, and was not given by the judges of the Supreme Court. Nevertheless, for a century and a half, more or less, we have accepted that a corporation is a person, and it seems to go back to that relatively minor case, and to a mere note by a court reporter, even though that was *not* expressed in the judgement. (Ah, the days before direct-recorded transcripts and word processors!)

An American law dictionary, Gills gives a person as: *in law, an individual or incorporated group having certain legal rights and responsibilities*, and states: *A precise definition and delineation of the term [person] has been necessary for purposes of ascertaining those to whom the Fourteenth Amendment of the US Constitution afford its protection, since that Amendment expressly applies to* persons [6],which agrees with Hartmann's finding: An English law dictionary. Stewart only defines a person as: *the object of legal rights*, continuing with: *There are two kinds of legal persons, human beings and artificial persons such as corporations* [7]. However, that reference gives no background for *why* a corporation is a *legal person*.

Maybe in the long run that distinction makes no difference to company management or employment conditions. But it does mean the management (individual persons) of a firm is distinct from the firm itself (a *pseudo-person*). And, if we are to regard a company, a corporation, as a person, then it must have what is termed a *personality*.

THE CORPORATE PERSON ASSET

One's *personality*, the mask we show to those around us, we would fervently hope is an asset. Physical looks may not matter anywhere near as much as this non-physical thing, which comes out in behaviour, expressions, wit, and much else. An individual with a pleasing personality has an advantage in getting ahead of the crowd. So, what should a company have in order to stay *in front*? It is the non-tangible asset, its *corporate personality*.

We come now to defining what this vital asset is, and a definition of *corporate personality* is provided by Olins, who defined the term:

> *The phrases corporate identity, corporate image, corporate personality, visual identity, house style, design scheme and visual programme are all used more or less interchangeably and indiscriminately.*
> *Corporate personality embraces the subject at its most profound level. It is the soul, the persona, the spirit, the culture of the organisation in some way.*
> *A corporate personality is not necessarily something tangible that you can see, feel, or touch – although it may be.*
> *The tangible manifestation of a corporate personality is a corporate identity. It is the identity that projects and reflects the reality of the corporate personality.*
> *A corporate image is what people actually perceive of a corporate personality or a corporate identity* [8].

That lengthy quote has been given to present this author's conclusion that although Olins' book is good reading and provides a wealth of examples, this reader is left with a sensation that even after all the work he put into the writing, and all the work he had performed in his business, he was still uncertain how to express a definition of what he could see in the companies to which he referred. Since his publication (1978), possibly the first on this topic, there has been many other books with the same or similar titles, some of which go into the concept from a legal viewpoint (unfortunately, none available at the time of this writing). Even though Olins seems not to reach a firm conclusion, this author finds the term, and Olins' outlines of this intangible feature, compellingly attractive in the light of employers experienced, many of which provide local illustrations of the factors, which make up appealing and revolting corporate personalities.

However, there is no questioning that such a phantom as *corporate personality* does exist, and Olins' examples cover the certainty very well. The temptation to add a few from personal knowledge is irresistible, so, following Oscar Wilde's philosophy on temptation, here they are.

The illustrations which will be presented can be classed as *anecdotal evidence*, not the *best evidence*, but all we have, and to support their use we point out that Olins has used similar anecdotes, and even the grand master of management writing, Peter Drucker, has done likewise. So, we submit these as illustrative examples.

The starting point for a corporation's personality, when the corporation is established, is the personality of the founder, and to illustrate that take an engineer's short-term employment, during a period some thirty years ago with a firm in a Sydney western suburb.

This company reconditioned drums, 44-gallon, 200-litre, steel containers, and had bought out a smaller firm, which re-refined lubricating oil, located across the road, The engineer's employment was to manage the small refinery, but the employment contract was actually with the former, which had a corporate personality derived, as remarked by Olins, from the founder, the chief executive, who was a driving, profit-conscious, entrepreneurial type. His nature came out in the employment interview, both sides expressed interest in each other in discussion, then, a salary figure was offered. It was too small by a large fraction. The engineer thanked the CEO and his general manager, did not argue about the offer, just politely rejected it and quietly left. A week later, a phone call gave an invitation to resume negotiations, and a week after that there was agreement on a figure considerably higher, in a reasonable range for the job requirements.

During the short time with the company two factors became evident from visits to *headquarters*, the office of the drum reconditioning factory. One was that the equipment was a mixture of odds and ends put together as cheaply as possible, consistent with providing output (it all worked, though mysteriously), the other was there was no plan for improvement, everything was to go on forever as it was. The founder had built all this up from nothing (there was a commonly-known tale that his first office was a telephone booth). Employee's facilities were rather dreadful, and although there was some respect for what he had achieved no-one liked him; a chat with the factory foreman showed he would leave, if he could get another job.

The internally-perceived corporate personality matched that of the founder: maximum results for minimum expenditure, negotiate but only when forced by circumstances, shown in the interview and by the later re-offer. But the engineer shifted to another employer after nine months (and regards that time as his period of gestation as a plant manager).

And the externally-perceived personality? That was also available to this author, who had worked previously with a firm, which purchased reconditioned drums from the firm into which he had now moved, and the impression from the earlier contact was confirmed by the closer experience - simply, that the personality of the drum reconditioning was directed towards maximising profit for the owner, customer satisfaction was regarded lower, and employee conditions were well down the priority list.

The drum reconditioning firm still exists, it was taken over by others, with developments and improvements. Inter-industry gossip related that the original founder had sold out, after his wife left him. The oil re-refining business appears to have disappeared, perhaps forced out by combination of land value and environmental issues; however, other firms are still operating.

From Olins' analysis and the above we believe the corporate personality probably does come initially from the founder, and can, therefore, change after the founder leaves, which is what happened in the above case, but can also be transmitted down into and through the organisation from whoever is appointed at the top, illustrated by this example.

That was observed in the Australian subsidiary of a large international, England-based, company in the early 1970s period, when there was a major change in top management. In the earlier years, before 1970, the company concentrated (in addition to mundane matters such as customer satisfaction and profit) on what might be termed technical excellence, headed by a long-term managing director of the Australian *branch*. Several factories were built and operated successfully. In 1971, the Australian *branch* declared independence from the imperial ruler and changed the local name to show its purely Australian nature. Then, the managing director retired and was replaced by two joint-acting managing directors, a curious and unusual scheme, making many employees puzzled and asking: how can this work? Broadly, one managing director was an engineer, the other an accountant, and before very long the influence of the latter seemed to strengthen. There was a shift towards strict cost control, redundancy payouts were offered, the factory in which this author was an engineer was shut down, he was transferred to another, and redundancy followed. All that seems, in retrospect, to show a change in corporate personality as perceived by employees, coming from the top, though probably initiated and required by economic necessity of the time. However, it is highly likely there was no change in the personality perceived by outsiders, such as customers.

Two commentaries should be added to those two items. First, there is no regrets about either experience or the outcomes, both were valuable in many ways; for example, they provided knowledge useful in later positions and contributed to writing output - not only this present article, but much else besides that. Second, rereading the above brings forth a strong sensation of just how very intangible *corporate personality* is; very clear to the person who was experiencing them, but presenting them lacks anything like equal impact.

AND THE REVERSE?

The above section has focussed on the effect a corporate head can have on the corporate organisation, in forming, establishing, or continuing a corporate personality. Can the reverse occur? Recent events in a major retail company have demonstrated that can occur.

The events, according to what has been in the daily press, began with an employee of David Jones making a complaint about the behaviour of a high-level executive. Within a few days more details appeared. Also, within a very short number of days that executive left the company; we are left uncertain, whether he jumped or was pushed, but what has been printed has a general tone that his departure was assisted.

The company's board has made clear *the company* could not have a senior manager behaving as described. The term *corporate personality* has not appeared in the board's remarks, but there has been enough to show that has been their concern. David Jones presents itself as very up-market, well above the major competitor, perhaps a little lower than the angels represented by Marks and Spencer or Harrods, but with similar notions (and a private brand), infused with an atmosphere to attract women of all ages (and preferably well-funded). The word *common* could never be used in reference to anything in David Jones, but if a very senior manager were found to be propositioning a younger member of the staff - it is very evident that the board had a *corporate personality* image in danger of being damaged, and the possible consequences horrified them.

To an observer, there is something almost amusing in the whole affair, but within the company we see Queen Victoria's reaction to doubtful humour. They were not amused, got rid of the offending person, hushed up what they could, and did everything necessary to restore the personality cultivated by years of public relations hard work. So, to defend the corporate personality, the chief executive had to go. And, the share price barely moved.

MAINTAINING A GOOD PERSONALITY

We should look at this, first, as Olins did, from the viewpoint of the external observers, customers and suppliers. With the latter, for example, there is simple financial matters such as having cash flow adequate to cover all expenses. The other side of that, paying suppliers of goods and services is also important, word about a slow payer can spread through a business segment very easily by anyone who has had to wait over ninety days. For both creditors and debtors, it is important to have a system, which checks and follows up slow payments. As an example, which lacked that is available from this author's background; he worked in the 1960s with a firm which had a company secretary who had a *bottom drawer*, into which invoices trivial-to-her-eyes were consigned and only brought out when the supplier applied pressure. These factors become under control when a firm has a governance system, following from a *good* corporate personality, overseeing such matters, thus avoiding financial sins, whether deadly or otherwise.

Some of the above relates to ethics, a very difficult business area, said, in a business sense to be similar to military intelligence (or, also, in today's climate, political intelligence - or ethics?). Just as common human behaviour is specified by certain well-known rules (for example, the usual ten, although there is more than those) corporate ethics is regulated at least to some extent by statutes and regulations, which, unfortunately, can be shunned just as an individual can ignore those rules.

A situation related to pressure vessel regulations provides an engineering example. In the 1970s, there was a company with a very cavalier attitude to pressure vessels; in the factory, there were many pressure vessels with isolation valves under the relief valves, and there were a couple of large process vessels, about 12,000 litres in capacity, which were regularly pressurised to somewhat between one and two atmospheres to empty out products, even though they were not certified as pressure vessels. The situation persisted for many years. The company's attitude appeared to be: *we've been doing this for years, nothing's gone wrong, so why bother with regulations*? Then, one day a government inspector arrived asking pointed questions and stressing the regulations to a more senior manager, after which the company was instructed to install pumps to discharge the product instead of using pressure. Following completion of that work, there was gossip, contained rather closely within a small group, that a junior engineer had become fed up with the company's attitude, and caused the inspector's visit. No prosecution followed, but the company was watched.

Repetition of accidents is another illustrator of personality-failure. A recent investigation is an example of that shows how such an incident can impact on an organisation's credibility. This author was hired as an expert witness to provide material for defence of a company operating a factory processing agricultural products, in a case of an employed worker who sued the company, after having a hand injured in a machine, which had been inadequately guarded. By the time of inspecting the factory, extra guards had been fitted as directed by Workcover, showing (more than less) that the company admitted the guarding had been inadequate. Then, during investigation of what happened, the escorting foreman demonstrated that removing the guard over the drive V-belts on the same machine was common practice, and although that part of the machine had not caused the injury, that discovery would have given a bad impression to any investigator who was a mechanical engineer. So did observing, on the very day of visiting the factory, that another worker was injured by getting his fingers into a toothed belt drive, after he had removed the guard. The speed with which a Workcover inspector arrived (within a couple of hours, to a location way outside the metropolitan area) gave the impression the company was being watched; so, as well as the direct and indirect costs of the actual accidents, there

could be the cost of fines after prosecution. The other indirect cost is standing in the local community, as an employer; in a small country town *the word* gets around.

Those examples show that the perception of a firm's corporate personality in the mind of a government department, and of the local community, can be seriously affected by accidents, or by unsafe working conditions. All the above lack of adequate compliance with good business practices depends on the individual's (or the corporation's) personality.

The above are examples from the recent past; however, a company should also maintain the future (perhaps an odd way of expressing this idea, but it is important) by observing economic trends. The example quoted from early last century was the demise of the firms producing buggy whips, who were pushed out of business by the introduction of the horseless carriage, and a more homely and recent example is the shift from laundry soap to detergent; a soap manufacturer who continued that line would have found sales dropping below survival level. Another has been the introduction of the PVA-based water-soluble paints, have taken the place of the resin-based solvent-thinned paints, which in turn had taken over from the old lead-based paints. Looking after the future requires having a development, think-tank, programme, possibly combined with research, to look at what is happening, what the rest of the world is doing, where events are leading, and what should be done about it. At least to keep up, preferably to get ahead.

David Jones board has obviously been concerned about the future, they have sent out a circular letter to all shareholders (presumably all), referring to what happened as *deeply regrettable* and contrary to the firm's *Code of Ethics and Conduct*. Concluding the man's employment is described as *mutual*, and one would assume that means he agreed with the Board that he should go - but, of course, he could have been given an offer he could not refuse. The content of the letter, through to the second page, which is about the new chief executive, is certainly looking at maintaining DJ's image in the future.

Summing up: there are many ways in which a corporation can exhibit a *bad* personality, and there are, possibly, fewer ways of presenting a *good* personality, apart from avoiding the sins leading to the *bad* type. Can we imagine a firm being seen as *good* by creditors, debtors, employees, the law and government bodies? Achieving that level seems unlikely. Managers can only work towards that desirable state.

RELATIONSHIPS

The relationship between the two *persons* described above, individual employees and the firm, is intricately interwoven. On the one hand, employees at all levels can (and, one may say, should) include extending their position as an asset by learning something new, and can request employer support for training they wish to obtain. From the other viewpoint, companies should (and certainly can) offer training opportunities to employees who demonstrate interest, and also should encourage employees to consider such development activities.

It is somewhat surprising that the Australian Bureau of Statistics has reported such a low figure for training provided by employers. One wonders what this indicates. Employee lack of opportunity or interest? Or employer lack of encouragement?

The other relationship which needs comment is the one between all the above thoughts about aspects of a firm's asset management. The connection is simply that some, or in many ways one could say all, of the above items relate to the integrity of the business, and that must be maintained very carefully, because it is the major asset of a corporation. Integrity is an old-fashioned word for a quite intangible asset, but one which is very real. The recent Opes scandal (and many others in financial circles), which, admittedly was not about a technology-based company, shows how a failure to govern correctly can lead to a situation where no-one has faith in the company, because its integrity has been severely damaged, and it faces serious attack not only by share-holders but also via the legal system.

Two of the above cases illustrate the same loss of integrity in companies using technology; both, the firm which dodged the pressure vessel regulations and the one which had the repeat accident, came under intense scrutiny by government bodies. Even if the inspectors' office is in another city, knowing those watch-dogs are peering over the corporate shoulder is uncomfortable.

One question left hovering in the background is whether people with certain personal personality (deliberate tautology) are attracted to corporations with similar corporate personality? The only observation tending to cover that came from the firm, which changes from technical excellence to financial severity, certainly a number of people who suited (by their similarity) the early corporate personality left the firm, which left a concentration of the others.

CONCLUSIONS

This article began by exploring the notion of aiming high, of trying to be ahead of the pack, of becoming and being *Number One*, in, to begin, one's own assessment of oneself. From thinking about that one can only conclude there is nothing inherently wrong with having such a good opinion of that self-person, with the proviso, now voiced openly, that one's actions must uphold that held belief and not impact illegally or immorally on another person.

The origin of the *corporate person* concept has been explained, then the concept of corporate personality has been defined and explored, with a number of factors which are relevant, if a corporation wishes to be *Number One* in a business community. Similar factors have been presented for individuals. Examples and illustrations have been given for both. The effect of technology has been covered, also with a few examples.

So, if maintaining a *Number One* position is desirable, is it an easy proposition? Well, just expressing a personal opinion, it possibly, even probably, is fairly easy for an *individual-person*, provided that individual has the necessary madness needed to seek another Everest to climb, then to attempt to do it - whatever *it* is, in the immediate context. Progressing further into concluding opinions, it is probably, even almost certainly, more difficult for an organisation such as a corporation (or one such as a political party) because an *organisation-person* is composed of a number of *individual-persons*, who will inevitably have divergent and conflicting needs and objectives, which, in the long term, reduce the organisation's intended concentration of output and success level to some form of chaos.

That is for the past and present. Has there been, through recent years, any changes in the factors mentioned in this article, related to corporate personality? Limited observations suggest that some technology-based organisations have improved their seeking to be *Number One*, although one with which this author is trying to do business appears to be so burdened by its internal bureaucracy and political connection that nothing happens in even a long time. But some of those in the financial sector show tendencies towards lower standards, which suggests they are not maintaining those factors, indeed, one might suggest factors such as ethical behaviour were not there in the first place to be maintained. As for the behaviour of individuals? One may doubt there is any change, the nature of human nature pushes most of us, one way or another, towards looking after self and those immediately close, first.

Finally, is there a relevance to engineering education? Certainly there is, the concept of corporate personality should be given to students through the management and management-related subjects in engineering curricula, then, if an engineer feels uncomfortable in a work situation he or she may be able to understand why. Students at a BE level need to understand that their employing corporation has a personality, and they must live with it if they can. Higher level research students could investigate personality forms, and successes and failures associated with them.

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BIOGRAPHY

Ronald Bentley Ward entered professional engineering via an Associate Diploma in Mechanical Engineering from the Sydney Technical College following an apprenticeship in an aircraft engine manufacturing factory. He progressed from the diploma to a Bachelor of Engineering at the University of New South Wales (UNSW), Sydney, while working in the chemical industry on projects and maintenance, and during that time completed the Master of Business Administration at Macquarie University, Sydney. In the late 1970s, he worked for consultants, and in 1984 left industry to take a lecturer position at the University of Technology, Sydney (UTS), in the Faculty of Engineering, but specialising in non-technical subjects including management, communication, technological change and risk. The topic of his Doctor of Philosophy thesis (UNSW) led to private consulting work on industrial safety and analysing accidents, in which he still works after retiring from UTS in 2001, and in which area he has written over a hundred reports, in addition to over a hundred journal and conference papers, and several series of management case studies. In addition to that consulting work and writing, he is a company director and a Visiting Fellow at the UNSW.

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Vocational students in Thailand: collaborative learning via the Internet in groups of different sizes

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ABSTRACT: The effectiveness of collaboration in groups of different sizes and how students collaborate within each group were studied. The participants consisted of first year Diploma in Vocational Education students from two institutes in Thailand. The Web-based modules on digital technique were undertaken by groups of three, four and five members, 92 students in total. The ANOVA results showed that the group of three students earned the highest scores as compared to the other groups with different group sizes. The mean scores of the group of five students were the lowest scores and varied more than the other groups of different sizes. The results for collaboration in the groups of three students showed more academic and social communication than for other group sizes.

Keywords: Group sizes, co-operative learning, on-line learning/digital technique, vocational students

INTRODUCTION

Vocational curricula are designed for specific career objectives and, therefore, experience-based performance is emphasised. Students have to practise and gain practical experience in order to apply their skills in the real workplace. Schools must prepare educational programmes/methods of technical education that provide not only job skills but also thinking skills and opportunities for the highest order of collaborative work. To succeed in learning, students should be provided with suitable facilities and a suitable environment, and also suitable management tools, such as multimedia, job sheets, textbooks.

Collaborative Learning

Collaboration is one strategy to promote learning and the need to be well-managed. An effective process of collaborative learning could be implemented for tasks in the classroom and on the Web. Collaborative interaction on the Web is asynchronous through e-mails, chat or a Web site and shows the relationship among participants.

According to Shawn, collaboration could be on three levels viz. team, community and network collaboration. Basically, collaborative learning in class occurs after exact goals are set. Learners collaborate with one another for achieving their common goals. Instructors should design and manage appropriate activities for the learners to enhance collaboration in each team. Such activities include: problem setting for discussion or finding a solution; co-operative tasks (through reports, projects, performance using some skills); exercises or even tests [1].

Learning on the Web

Efficient management of Web-based learning is powerful, not only for learning but also for sharing knowledge among learners, which, in turn, supports learners to gain knowledge. Instructors should also concern themselves with stimulating the creation of effective e-learning environments, which include learning resources, learning support, activities and determining appropriate group sizes. Oliver suggests three critical elements of on-line learning designed to promote co-operative learning, i.e. learning design as a learning task, learning resources and learning support [2]. To manage collaboration on the Web, instructors ought to determine and design elements such as setting targets, the design of systems and models of collaboration.

Web-based collaborative learning has become a popular learning approach in education. Collaborative learning on the Web requires a different management and has a different impact from collaboration in the classroom. Zhao and Kanji studied Web-based collaborative learning strategies and pointed out that Web-based collaborative learning could be integrated with the traditional classroom learning process [3].

Group Sizes

Group size is an important factor in promoting learning. Small groups might be effective but they are more expensive. Co-operative groups let students share and organise their thoughts. Group communication on the Web is different from communication in an ordinary class because the latter communication must occur on a fixed schedule, whereas Web-based communication can take place anytime when learners feel free to learn. The effectiveness of group members depends on task types and purposes. In ordinary classes, large groups are better for discussions where members are exploring and collecting information. However, learners in large groups may have no chance to share their ideas or they might be dominated by other group members. However, groups must be large enough to ensure diversity [4]. In some tasks a greater group size might be of benefit, if the group could be managed in respect of the impact on performance and the benefits of collaboration. A suitable group size will support students in mastering their knowledge and also to effectively manage the curriculum.

Gorsky and Chajut studied how discussion was affected by group size in distance learning. It was found that the proportion of learner-learner interactions increased as group size increased, while the proportion of instructor messages decreases [5]. In the case of learning modules on the Web, large groups may face problems with communication given learners' varied skills in using technologies and the systems and facilities provided for communication. If instructors allow enough time, they have the possibility of adequate communication. If learners do not have to do much work on the Web, and it is not necessary to communicate with or share ideas in large groups, small groups might be more convenient. Moreover, the characteristics of group members are another important component of group working [6].

Some group members may prefer to use e-mails or Web boards because they have better skills in these technologies, but other members of the same group may have less skill in such technologies. Thus, these may fail to respond to group communications. Therefore, instructors have to assign activities suitable to all members concerned. Instructors have to guide, follow up and provide their students with appropriate facilities. For classroom learning, students are normally assigned to a four-member learning team. In the context of learning on the Web, group size is an important factor that requires investigation to determine the impact on group interaction. Interaction patterns and learning benefits are affected, if there are two members or between three and six members, especially, if equal participation or collaborative products are to be produced [7]. Small groups generally mean greater member involvement, but they may not have sufficient resources and the ability to engage in discussion of every potential solution [8].

As a group becomes larger, the emotional identification and sense of deeply shared commitment becomes more difficult to establish and maintain; therefore, members in larger groups are less satisfied [9]. As group size increases, the efforts of individuals seem to decline. However, groups must be large enough to ensure diversity [4]. The studies of synchronous collaborative activities through modules on the Web usually involve two partners. If a greater group size could be managed in its impact on performance and collaboration, it might be beneficial to design activities.

OBJECTIVES

To explore students' collaborative learning on a Web module, in groups of different sizes, was the objective of this study.

PROCEDURE

Model used for learning design: Web-based instruction (WBI) modules for learning on digital technique combined with collaboration were developed for three dimensions: analysis, design, and systems for learning; then, the collaboration model was set. There were three dimensions for the collaboration: 1) For each unit to do an assignment together; 2) To collaborate in a team by asking questions and receiving answers from other members using a Web board; and 3) To discuss the questions/problems in real time and to send the e-mails to each other within the team.

Computer network and other facilities were created to support the system. Students were also trained to use the network. They were designed to be groups of three, four or five. Each group was assigned tasks and exercises on the network. Internet protocol addresses for each specific group were set to check the student records. Each member of the group had to log in a fixed number of times.

The sample was 92 vocational students from two institutes in Thailand, who studied in the field of Electronics, Electronics Communication and Computer Techniques. They were divided into three, four and five members per group. Each group consisted of students of various abilities.

The tools were: 1) Web-based instruction modules on digital technique; 2) Test; and 3) Questionnaire. These tools were developed and assessed by experts on content validity and, also tested for improvement before the real experiment.

Data collection: WBI on digital technique was applied on the Web. Each group agreed to work together to complete their tasks in time. For learning activities, students had to share their knowledge through questions and answers, search for more information and do the exercises. They also had to utilise the Web board, chat room, and e-mails to their team members and instructors. Tests were conducted before and after the experiment.

RESULTS

Effects on achievement: Mean and standard deviations by group and the pre-test and post-test scores for groups of three, four and five members are shown in Table 1.

Table 1: Mean scores and standard deviation on post-test scores of each group size.

Group Size		1	2	3	4	5	6	7 8		9	10	Total Pre-test	Total Post-test
3	$\overline{X}$	33.67	32.33	31.33	34.00	35.00	32.00	33.00	32.33	30.00	30.67	13.10	32.43
	SD	1.15	1.53	1.53	1.00	1.00	2.00	1.73	1.53	1.00	2.52	2.01	1.98
4	$\overline{X}$	32.50	31.75	33.50	32.25	31.71	33.00	33.25	28.75			16.03	32.09
	SD	2.38	0.50	1.29	1.26	0.50	2.71	1.71	2.99			3.39	2.19
5	$\overline{X}$	28.40	28.20	29.60	29.60	30.20	29.20					13.60	29.03
	SD	2.97	3.19	3.36	3.36	1.30	2.39					2.13	2.68

The mean scores of groups of three members were significantly different from groups of four or five members. However, there was no significant difference between groups of four and five members. Groups of three had more, but less varied scores than the two other group sizes. Their standard deviation ranged from 1.00 to 2.52. They obtained the highest mean earned scores. Groups of five obtained the lowest post-test score. The highest score for groups of five members was 30.20, and the lowest was 28.20. The standard deviation varied more than the other two group sizes (SD between 1.3 and 3.36). Groups of four obtained moderate post-test mean scores; however, their standard deviation was quite varied (0.50 to 2.99).

The Study of Students' Collaboration in Groups

Students were asked to report how they contacted one another in two aspects; communication on the Web and social communication (without their names in the reports). They were observed by the researchers' assistants in order to check their reports. The data on collaboration by each group were analysed. The amount of collaborative learning inside groups of three, four and five members was compared.

Table 2: Percentage among groups of collaborative learning on the Web.

Frequency	More than once a week (%)			Once a week (%)			Less than once a week (%)		
Item/Group sizes	3	4	5	3	4	5	3	4	5
Communication on Web									
1. Exercise	46.67	28.13	13.33	40.00	53.13	60.00	13.33	18.75	26.67
2. Assignment	60.00	46.88	26.67	33.33	40.63	46.67	6.67	12.50	26.67
3. Question and answer on white board	43.33	28.13	23.33	43.33	56.25	56.67	13.33	15.63	20.00
4. Chat about lessons	60.00	43.75	20.00	33.33	40.63	66.67	6.67	15.63	13.33
5. Email	53.33	25.00	13.33	23.33	34.38	20.00	23.73	40.63	66.67
Communication outside Web									
6. Discussion about learning problems	46.67	21.88	10.00	40.00	50.00	33.33	13.33	28.13	56.67
7. Discussion about other problems	16.67	6.25	6.67	40.00	18.75	13.33	43.33	75.01	80
8. Chat about general topics	50.00	40.63	23.33	40.00	46.88	40.00	10	12.94	36.67
9. Other communications with other members	23.33	9.37	6.67	30.00	15.63	6.67	46.66	68.75	86.66
10. Help members in general tasks	23.33	15.63	13.33	53.33	34.38	20.00	20	50	66.66

The communication/collaboration was recorded as *more than once a week* for a learning unit, *once a week*, and *less than once a week*. As a whole, students collaborated with other group members, both in academic and social aspects. The percentage of their collaboration in all items for groups of three was quite good at *more than once a week*, except for discussions about other problems.

The behaviour of groups of different sizes was determined in order to find out the collaborative efficiency for each group size. Group sizes of five showed the least collaboration in many aspects. The results in percentage terms are shown in Table 2.

From Table 2, the percentages of collaboration on the Web (more than once a week) are shown in Figure 1 and outside the Web in Figure 2.

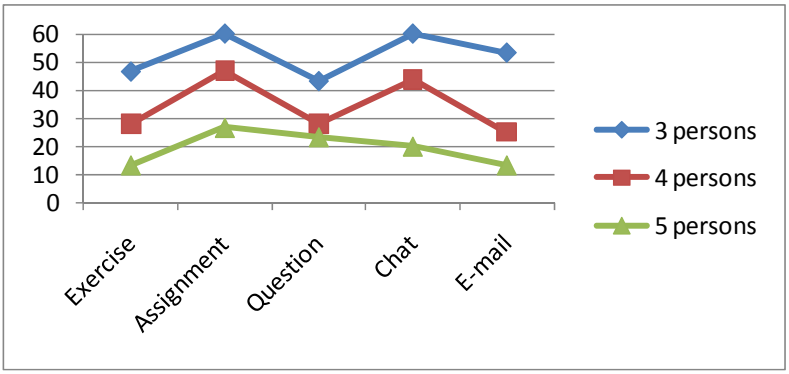

Figure 1: Collaborative learning on the Web: more than once a week.

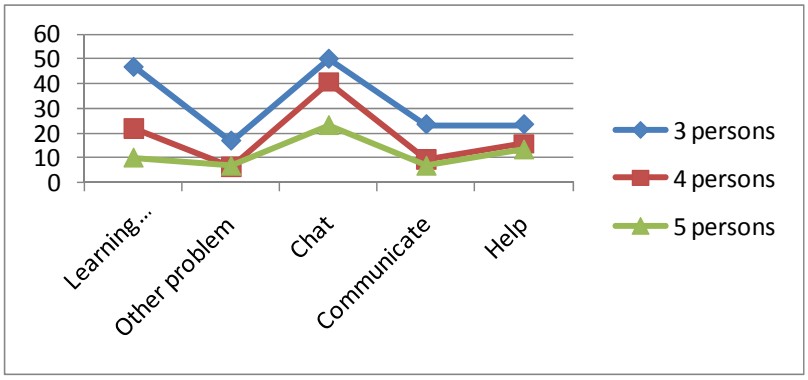

Figure 2: Collaborative learning outside the Web: more than once a week.

Figure 1 shows the percentages for collaborative learning on the Web in groups of three, four and five members, and includes exercises, assignments, questions and answers on the Web board, chats about lessons and e-mails about lessons. The percentage of collaboration in groups of three members *more than once a week* was the highest for all items. The collaborative percentage for groups of four members was higher (four in five items; except for e-mails) than for groups of five members.

Figure 2 shows the collaborative learning outside the Web (social aspects) in groups of three, four and five members for *more than once a week*, and includes discussions about learning problems and other problems, chats about general topics, other communications and helping members in general tasks. The collaborative percentage for groups of three was the highest for almost all items.

Group assistants were asked to assess group activities and their records supported the above results. It was also consistent with learners' reports. In studying digital technique, groups of small size showed more collaboration and communications in academic and social aspects than the other groups of larger size. The students were asked to evaluate the learning in ten aspects. Means and standard deviations of groups were compared by group sizes, as shown in Table 3.

Table 3 shows that, on the whole, students' evaluation of learning digital technique on the Web was quite good, especially for the item of *feel free to learn*. The mean scores of students' opinions for groups of three members were higher than the two other group sizes in all items ($\overline{X}$ =4.90 to 3.63). The mean scores of groups of five members were the lowest in every aspect ($\overline{X}$ =4.50 to 2.07).

Table 3: Mean score and standard deviation of students' opinions toward learning on the Web, by group size.

Item	3 persons		4 persons		5 persons	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1. Convenience to accessibility	4.73	0.45	4.19	0.64	3.6	0.76
2. Suitable time to learn	4.53	0.68	4.41	0.71	4.50	0.68
3. Method of learning on Web	3.73	0.94	3.75	0.80	3.47	0.97
4. Supplementary exercises	4.17	0.83	3.63	0.96	2.93	0.78
5. Knowledge from learning units	4.33	0.48	4.00	0.51	3.57	0.50
6. Feel free to learn	4.90	0.40	4.53	0.72	4.40	0.67
7. Equipment support learning on Web	4.70	0.53	4.16	0.81	3.83	1.02
8. Convenient to use e-mail	4.33	0.66	3.66	0.97	3.13	0.90
9. Time spent for self learning	3.97	0.93	2.91	1.09	2.50	1.17
10. Convenient to use Search Engine	3.63	0.81	3.09	1.20	2.07	1.08

DISCUSSION

Regarding learning digital technique via the Internet, students in groups of different sizes were able to achieve significantly higher post-test scores. This was consistent with Chanchalor and Powichai, who studied the effect of distance learning via the Internet on electric motor control and found that students obtained higher scores on the post-test than the pre-test [10]. This finding confirmed that learning on the Web was helpful and, as effective as traditional classroom learning; researchers applied instructional design theories to Web development, and to determine and analyse strategies. The learning module was designed for collaboration in groups' support learning. Students may learn through the assistance of other group members.

The results can be attributed to several factors. One factor was connected to the innovation of learning on the Internet. Another factor was the design of this multimedia technology, which attracted the attention of technical and teenage students. This multimedia technology could help students and be an alternative to providing pages of plain text.

According to the results, the most effective group size for collaborative learning on the Web for this course was three. Fisher et al mention that group size has a significant impact on group success [11]. Groups of three members were able to acquire knowledge easily and consume less material or equipment than groups of two. Groups of five learners achieved the lowest scores, as Ditza et al investigated the effects of two context variables on small group learning (group sizes of three, four and five members), and found that groups of three members elicited more integrated and general learning behaviour, while groups of five members elicited more co-operative learning behaviour, listening and social interaction [12].

With collaborative behaviour, small groups had a better chance to communicate, as Lowry et al and Chen et al found in their studies on the impact of varying group size and social presence on small group communication [13][14]. The smaller groups established and maintained a higher level and quality of communications. Groups with the combination of face-to-face and computer-mediated communication had higher levels of quality communication than other groups using only computer-mediated communications.

The percentage of communication (exercises, assignments, questions on Web board, chats and e-mails.) for all group members was quite high. This was a result of the module design requiring collaborative working, and system management. Wagner et al studied the effects of group size on problem-solving and suggested that groups of three to five people performed better than individuals when solving complex problems [15]. In this study, the interaction of groups of three was more frequent in all aspects than any other group size. The group members of three were closer and felt freer to communicate and could better interact and exchange knowledge on Web-based learning. Thus, their scores did not vary much. This group size might have been suitable for collaborative learning and the module system of WBI for digital technique.

CONCLUSIONS

Lave and Wenger mention that learning performance is strongly affected by peers [16]. Larger groups may have less convenient communication through the Web. The evidence from this study which confirmed this, was that the mean scores on the post-tests for three-member groups were higher but less varied than for groups of four or five (Table 3). The mean scores of groups of four and five showed no significant difference. Therefore, where there is limited equipment availability, groups of five members, instead of four, could be managed in learning through Web modules. However, groups of five seem to be poor in enhancing students' behaviour in Web collaboration. Thus, groups of three students showed more satisfaction with learning on the Web, in every item, as compared to any other group size.

It was also noticed that students with good backgrounds or more experience with computers could learn faster than those with less experience. Stein and Calvin state that lack of experience with the technology, frequency of feedback,

language barriers, group size and subject matter impacted students' learning [17]. Thus, students should be trained in this competence and networking system to improve their efficiency and to make learning more convenient.

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BIOGRAPHIES

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Rural teachers' acceptance of interactive white board-based ICT in Taiwan

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ABSTRACT: In order to understand the realistic use and impact of interactive white boards (IWB) on ICT in Taiwan, a survey was used to gather information on teachers' perceptions. The technology acceptance model was used as the theoretical basis in this study. Collected data were analysed using the structural equation modelling technique (SEM). A total of 335 questionnaires were retrieved from 114 rural schools, a return rate of 62.28%. The confirmatory factor analysis (CFA) test by SEM showed a satisfactory model fit to the hypothetical model. Important results were: 1) Perceived ease of use (PEU) has a positive and direct impact on perceived usefulness (PU), indicating that IWB are favoured by teachers and encounters zero resistance; 2) PEU and PU both have a positive and direct impact on behavioural intentions to use (BI), indirectly suggesting that greater convenience and practicability of IWB can increase teachers' intention to use IWB; and 3) Behavioural intention to use IWB has a direct impact on actual system use, which demonstrates that IWB-based teaching environments already have been widely integrated by teachers into their teaching methods.

Keywords: Rural teachers, interactive white board, technology acceptance model, structural equation modelling

INTRODUCTION

In this age of information and communication technology (ICT), digital products have become an indispensable part of individuals' daily lives, learning, work and entertainment. The impact has transformed communication from one-way to multi-dimensional in which users become information participants or providers rather than passive receivers. In view of this, a new digital learning ecology has gradually developed. One urgent task for educational authorities in all nations is to improve students' learning ability through the utilisation of digital methods. Taiwan's Ministry of Education had recognised global ICT trends in the 1980s. The *General Guidelines of Grade 1-9 Curriculum of Elementary and Junior High School Education*, published in 2001, clearly states that ICT education should be incorporated into all curricula, demanding specifically that students should have the ability of *knowing* and *doing*, while teachers should fully apply ICT to more than 20% of teaching activities [1][2].

In addition, the Ministry of Education and the National Science Council have been vigorously promoting the ICT integrated teaching plan since 2007, the major purposes of which are to assist teachers in acquiring various digital teaching materials and to synthesise and construct data into an integrated platform of teaching resources that can serve as a share and exchange mechanism. In the earliest phase, the basic construction of different information platforms was accomplished (Internet, information equipment, free software and electronic classrooms). In the second phase, a digital information centre was established. Teaching and promotion were integrated in the third phase, and systems and regulations in the fourth phase. In the fifth phase, teacher training and ability indicators were accomplished. The final phase was the development of students' information literacy and ability [3].

According to the White Paper on IT in K-12 Education, teacher information outlines were included into teaching action plans. Teachers are expected to satisfy the National Educational Technology Standards for Teacher (NETS for teachers, NETS•T) [3]. In the meantime, the Taiwanese Government has budgeted for the renewal of computer facilities in elementary and middle schools in all cities and counties, as well as subsidising schools to establish *e-learning: interactive white boards* (IWB*) classrooms* [4]. As IWB teaching systems are only in the beginning stage, teachers' habits of use and teaching efficacy need to be evaluated over time. If IWB-based e-learning activities are to be comprehensively integrated, a few issues need to be considered. The first needs to address the digital divide. The other is to introduce a student-oriented digital learning environment. Finally, teachers' intentions and learning efficacy should be evaluated [5][6]. The Public Broadcasting Service (PBS) survey showed that a relatively lower proportion of teachers use technological media in teaching, which seemed to be at odds with contemporary learning models [7].

An improvement in this situation requires teachers' acceptance and execution of ICT [8-10]. In particular, modern teachers enable and facilitate learning and, therefore, how teachers handle newly developed educational technology and lead students to the next generation of learning is critical.

Pingtung County in Taiwan, which is located in the southernmost part of Taiwan, was chosen in this study as the research location. Because of its remote location and lack of educational resources, the county must receive yearly sponsorship from the educational priority area (EPA) project. Based on this, and another project that creates digital opportunities for rural areas, since 2009, the Pingtung Government has subsidised all rural schools to establish multi-functional digital classrooms, and has purchased one to three sets of IWB-related facilities for each school in order to reduce the digital divide. When the facilities arrived, each school organised relevant workshops and teaching demonstrations, expecting to improve behavioural use intention (intention to use IWB) and teaching efficacy. Accordingly, this study seeks to understand teachers' attitude towards behavioural intention to use, and actual systematic use of, an IWB-based ICT teaching environment, so as to serve as a reference for the future promotion of such systems.

LITERATURE REVIEW

Teaching Environment in the ICT Age

Information and Communications Technology has become a developmental focus of education reform worldwide. As users' behavioural intention and actual use of computers have significantly increased, differences between the information rich and the information poor still exist [11]. A study by the National Telecommunications and Information Administration in the US suggested that the digital divide has become an indisputable fact [12]. The Organisation for Economic Co-operation and Development (OECD) pointed out in the book *Understanding the Digital Divide* that the reasons contributing to this phenomenon are many and varied, including internal factors and external environmental factors [13]. Many studies have examined the conditions causing the digital divide. For instance, the International Labour Organisation (ILO) and OECD both proposed that gender, age, ethnicity, language, education and location are all associated with the digital divide [14].

An external digital environment requires usage opportunities, content access, technological literacy and community [15]. To solve the aforementioned problems requires a combination of efforts from different parties. Governments, as forces of reform, should design related policies and provide long-term support for the ICT education industry, so that minority groups do not suffer double social exclusion [16]. Corporations and enterprises should serve as system developers, providing diverse and appropriate digital facilities, fulfilling their social responsibilities. Education authorities should serve as promoters responsible for budgeting and educational training, as well as for a digital paradigm shift. Front-line teachers are the executors of this paradigm shift and should not only pay attention to current development opportunities in ICT, but also realise that digital learning has become an indispensable part of teaching [17][18].

Teachers cannot oppose this change; instead, they should enhance their own information literacy. They should combine personal educational expertise and knowledge to analyse, design, develop, practise and evaluate the construction of a systematic teaching model, transforming curricula and teaching materials into digital formats and evaluating learning efficacy [19]. Although early studies disputed the learning efficacy of digital media, without a doubt, digital teaching has become deeply rooted in education [20-25]. Studies have pointed out that the key factor in the promotion of ICT lies in the guidance to curricula and teaching, rather than the technology itself [26]. If teachers fail to fully utilise the advantages of ICT, the value of electronic learning is naturally reduced.

If teachers adopt more ICT content in their interactions with students, learning interest and efficacy will show a healthy improvement. The main factor that hinders teachers is that an ICT teaching platform involves changes in the interactive environment. A study by Gilbert and Moore pointed out that a dynamic interactive teaching model has an impact on learning efficacy, especially on higher levels of cognitive learning [27].

Particularly in recent years, as ICT-related facilities have been upgraded, teachers have gradually given up the conventional chalk and blackboard approach and adopted digital materials instead. Projectors and Web platforms have provided a more efficient teaching model [28]. Promotion and utilisation of an IWB-based ICT teaching platform has also been helped by an upsurge in educational technology in recent years. A research group from Keele University in Great Britain has developed teaching resources and software for IWB, and has offered the results to elementary and middle school teachers for free use and sharing [29]. A further related study confirmed that when IWB is used in teaching, students may actively acquire ICT knowledge and skills, hence improving their ICT literacy without their noticing [30].

The DCSF Primary Schools Whiteboard Expansion Project found that the long-term use of IWB can effectively improve students' learning efficacy, no matter whether in mathematics, science or English composition [31]. Another study indicated that schools should consider three key factors when introducing IWB: technical support, teachers' expertise and behavioural intention to use [32]. Relevant studies have shown that teachers' behavioural intention to use and ability to develop an IWB system form an invisible wall hindering improvements in teaching [33][34].

Most IWB-based electronic classrooms currently promoted in Taiwan are designed and provided by manufacturers. Therefore, teachers are less familiar with the use of this environment and with the software and hardware. Hence, appropriate teaching concepts and habits need to be cultivated. At the same time, there is a lack of empirical studies of teaching efficacy, which is an obstacle to an increase in usage among elementary and middle school teachers. To sum up, a good ICT teaching platform requires more than just purchasing software and hardware. The electronic system should not just be impressive in appearance. What is really needed is the combination of teachers' self-awareness and action. This study particularly focused on whether rural teachers can understand the distinction between feasibility, perceived ease of use and practicability of an innovative teaching platform through a process of self-evaluation. Understanding of these distinctions is considered the key factor in the success, or otherwise, of an ICT integrated teaching plan.

Technology Acceptance Model (TAM)

The technology acceptance model (TAM) was used to examine the relation between perceptional and affectional factors in the use of information technology facilities based on the theory of reasoned action (TRA) [35][36]. The major objective of this model is to explain users' acceptance and adoption of information technology in terms of users' internally perceived viewpoints. In other words, this model is used to understand more about the impact of external factors on users' internal attitudes, beliefs and intentions, and also on users' use of technology [37]. As a result, TAM is an oft-applied theory in studies on user acceptance of technology [38]. When applying TAM, several basic assumptions need to be made [39], as follows:

1. The two most important concepts affecting individuals' attitudes towards uses of new technologies are: perceived usefulness (PU) and perceived ease of use (PEU). In 1989, Davis defined PU as the objectively expected probability of work or learning performance being improved by the use of a specific system; PEU refers to the ease in using the system. In other words, if a user considers a system to have a higher level of PEU, it is more likely to impact the PU [40].
2. If individuals consider information technology easy to use and useful for their work, it impacts not only on their behavioural intention to use (BI) but also directly on their actual system use (AU).
3. When potential users possess more positive attitudes towards a new technology, they will have a stronger behavioural intention to use it. Similarly, when users' behavioural intention to use is stronger, their actual system use is assumed to be more significant.

RESEARCH METHOD

This study conducted a questionnaire survey to understand elementary and middle school teachers' acceptance of an IWB-based ICT teaching platform. The hypothetical model was established based on TAM. The question items were adapted from Davis and constructed according to PU, PEU, BI and AU [40]. A Likert seven point scale was used, ranging from highly agree to highly disagree. The research subjects for the general survey were seed teachers who have completed educational training and were from 114 rural regional elementary and middle schools with ICT classrooms in Pingtung County.

A total number of 570 copies of questionnaire were distributed, and 355 valid samples were collected (62.28 %). As it was intended to analyse a hypothetical mode, traditional factor analysis could not effectively and comprehensively examine the structural relation (casual relation) between factors (latent variables) [41]. Therefore, the structural equation modelling (SEM) method was adopted. The statistical software SPSS 17.0 and AMOS 17.0 were the analytical tools used in this study. The SEM analysis procedure was: 1) examine, if the hypothetical model is accepted by confirmatory factor analysis (CFA); 2) examine the latent relation and model fit of SEM; and 3) conduct path analysis. According to the TAM theory, PEU should have an impact on PU, and have a further impact on BI and AU. The research structure is presented in Figure 1, and Table 1 shows the research hypotheses.

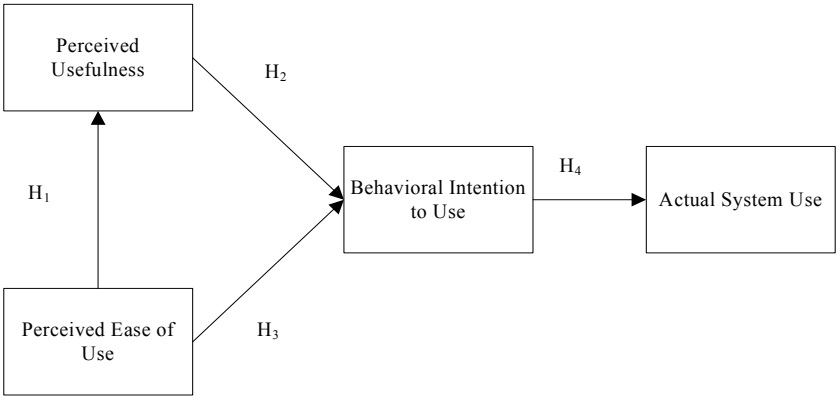

Figure 1: Research framework.

Table 1: Research hypotheses.

Hypothesis	Content
Hypothesis 1	PEU has a positive impact on perceived usefulness PU.
Hypothesis 2	PU has a positive impact on BI.
Hypothesis 3	PEU has a positive impact on BI.
Hypothesis 4	BI has a positive impact on AU.

ANALYTICAL RESULTS

The descriptive statistics show that respondents all have a high level of acceptance of IWB-based ICT teaching environments, with an average score between 4.85 and 5.17. The highest score is BI, while AU is the lowest. In order to present the measure effects between latent variables and observed variables, as well as the casual relation between latent variables, this study verified the hypothetical model using SEM, a process which involved two parts.

Confirmatory Factor Analysis (CFA)

This study used confirmatory factor analysis to examine the co-variance relation between the observed variables and latent variables, as well as calculating the convergent and discrimination validity of the CFA-measured model, as shown in Table 2. Confirmatory factor analysis shows that the factor loading of estimated parameters of all observed variables is larger than 0.45, with its multiple correlation square value larger than 0.2, indicating convergent validity [42][43]. The model also satisfies the standard of discrimination validity, with each value between 0.78 and 0.81. The standard was determined by the AVE root square value of each aspect being larger than 75% of the loading of the correlation coefficient of each aspect [44]. The composite reliability (CR) of this study was between 0.83, and 0.86 and its average variance extracted (AVE) was between 0.61 and 0.66, both larger than the suggested values of 0.6 and 0.5 [45]. The aforementioned figures show that all the observed variables in this research structure can reflect the constructed latent variables.

Table 2: Confirmatory factor analysis of the model.

Observed Variables	M	SD	SK	KU	SFL	SMC	EV	CR	AVE
Perceived Usefulness	5.000							0.86	0.61
instruction improvement	5.044	1.169	0.050	-0.570	0.86*	0.74	0.74*		
instruction performance	5.196	1.202	-0.048	-0.698	0.82*	0.67	0.66*		
instruction efficiency	4.554	1.467	-0.066	-0.791	0.73*	0.53	0.53*		
instruction effective	5.211	1.174	0.031	-0.779	0.86*	0.74	0.73*		
Perceived Ease of Use	5.000							0.85	0.66
learning easily	5.162	1.139	-0.104	-0.425	0.87*	0.76	0.75*		
understanding easily	5.026	1.173	-0.058	-0.458	0.85*	0.72	0.72*		
presenting easily	4.823	1.305	-0.100	-0.533	0.75*	0.56	0.57*		
Behaviour Intention	5.167							0.84	0.63
try to use	4.773	1.349	0.199	-0.775	0.73*	0.53	0.54*		
need to use	5.513	1.125	-0.297	-0.221	0.74*	0.55	0.54*		
like to use	5.217	1.183	-0.207	-0.249	0.51*	0.26	0.27*		
Actual Usage	4.845							0.83	0.62
use anywhere frequently	5.187	1.277	-0.333	-0.465	0.76*	0.58	0.58*		
use anyhow possibly	4.528	1.401	0.081	-0.804	0.85*	0.72	0.72*		
use appropriately	4.820	1.421	-0.224	-0.698	0.74*	0.58	0.55*		

Note: *p<0.05; *M*: mean; *SD*: standard deviation, *SK*: skewed, *KU*: Kurtosis, *SFL*: standardised factor loading, *SMC*: square multiple correlation, *EV*: error variance, *CR*: composite reliability, *AV*E: average of variance extracted

Overall Model Fit

The research model comprised four aspects, and each aspect was measured by three to four questions. The absolute fit measures of the overall model fit are: χ^2/df =3.372 (χ^2 =205.715, df=561, p<0.001), GFI = 0.918, AGFI = 0.877, SRMR = 0.052, RMSEA = 0.082. The relative fit measures include NFI = 0.924, IFI = 0.945, CFI = 0.945 and RFI = 0.902, while the parsimonious fit measures include PNFI = 0.722, PCFI = 0.739 and PGFI = 0.615. The comparison between sample data and the hypothetical model shows a satisfactory model fit. Figure 3 and Table 3 show that each path coefficient of the research hypotheses are significant and, therefore, are accepted. In other words, acceptance by teachers of an IWB-based teaching model shows a positive response in the interactions among PEU, PU, BI and AU. The relations between PEU and PU (0.88), as well as between BI and AU (0.70), have the strongest explanatory power.

In the overall model, perceptions can explain 56% and 49% of the variance in behavioural intention to use and actual system use respectively.

Table 3: SEM path analysis.

paths	*SRW*	*SE*	*t*-value
PEU→PU	0.88	0.78	17.437***
PU→BI	0.38	0.56	2.572**
PEU→BI	0.39	0.56	2.576**
BI→AU	0.70	0.49	8.329***

Note: *** p <.001, ** p <.01; SRW: standardised regression weights, SE: standard error

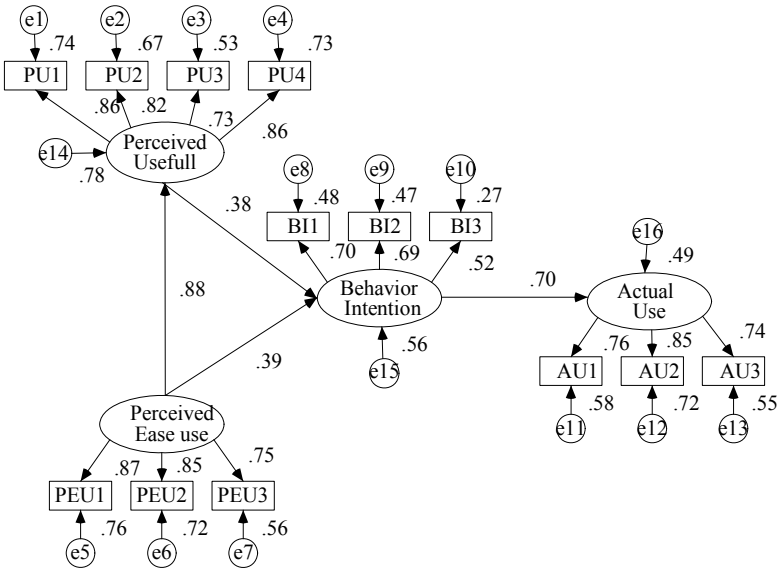

Figure 3: TAM structural model for rural teachers.

CONCLUSIONS

Teachers generally consider that ICT teaching models have matured; however, teachers have reservations over their actual applicability. In particular, the use of new teaching interface tools, such as IWB, still faces some challenges. This study examined teachers' acceptance of IWB use in schools in remote areas, in order to understand the impact of teacher perceptions, behavioural intention to use and actual system use. This study found that rural teachers show a high level of acceptance of both the observed variables and latent aspects of their perceptions. Adopting SEM, CFA was first used to confirm the model fit to the research hypotheses before further analyses.

The obtained results showed not only a satisfying model fit, but also the research hypotheses were accepted. Based on this, some conclusions can be drawn: 1) PEU has a positive impact on PU, showing that the user-friendly interface of IWB is favoured by teachers, and they do not encounter great difficulties or show resistance to learning and using it; 2) The positive and direct impact of both PEU and PU on BI were observed, which shows that higher the convenience and practicability of IWB use can enhance teachers' behavioural intention to use; and 3) BI has a direct impact on AU, showing that IWB-based teaching generally has been accepted by teachers in practice, and has been applied in actual teaching locations. Conclusions reached in this study correspond with many other ICT studies [46-48].

In other words, the preconditions for designing an ICT teaching system should be its perceived ease of use, and its practicability, so that teachers' behavioural intention to use will naturally increase, and their actual system use be improved. Therefore, this first principle should be considered during the promotion of policy by governments and educational administrators. Second, teachers' resistance can be reduced through practical on-the-job training or teaching demonstrations. Finally, promotion of ICT education is a long-term task. While concern about the digital divide among students is warranted, teachers' level of acceptance also should be considered in order to prevent an unnecessary waste of educational investment.

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Personality types of Cuban software developers

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ABSTRACT: The measurement of factors involved in human performance has become an essential step to move forward in the software industry. Psychometric measurement provides the needed understanding of human potential. The aim of this study was to establish the personality profile of Cuban software engineers according to the Myers-Briggs Type Indicator (MBTI). Analysis of the study shows that the most prominent personality type is a combination of extroversion, sensing, thinking and judging.

Keywords: Personality type, Myers-Briggs Type Indicator, human factors in software engineering

INTRODUCTION

Human factors in software engineering have different dimensions. Studies have been conducted from different perspectives. These perspectives could be the study of human factors in different phases of the software life cycle, or the effect of teamwork on software development, or how a personality profile can suit a particular task or about some other miscellaneous issues.

A classification scheme based upon the psychological type theory of Carl Jung, the Myers-Briggs Type Indicator (MBTI) personality inventory, has been used for decades to determine personality types [1]. Myers-Briggs Type Indicator also has been employed to improve teaching and learning. The Indicator defines four scales, as briefly described below, to assess personality types:

- Extroverts (E): are individuals whose attention is drawn toward objects and people; who tend to draw energy from the external world of people and things; and who prefer to communicate and process information verbally. Or Introverts (I): whose attention is drawn towards the inner world of ideas; who tend to draw energy from the internal world of ideas, emotions and impressions; and tend to process information internally.
- Sensing (S): attuned to the practical, hands-on, common-sense view of events. Or Intuitive (N): who are attuned to the complex interactions, theoretical implications, or new possibilities of events.
- Feeling (F): who weigh the human factors, and make judgments with personal conviction as to their value. Or Thinking (T): who draw conclusions or make judgments dispassionately and analytically and seek an objective standard of truth.
- Perceiving (P): who tend to keep their options open and are often viewed as spontaneous. Or Judging (J): who tend to seek closure, to be organised and want things settled.

Summarising, the MBTI sorts these four dichotomies – two traits in each dimension, one from each pair, to delineate a person's preferred type. Hence, there are 16 possible configurations, such as ISTJ, ESFP, ENTJ. If the MBTI indicates that a person is ISTP, it suggests that the person's preferences are the ISTP type. There are no rights or wrongs in the personality types, merely preferences.

The MBTI assessor can estimate the personality type of a person based on a score for each bipolar dimension. This score is calculated by the MBTI instruments. There is specific behaviour associated with each category. The MBTI's dichotomies indicate the preference in one of each category, meaning that a person could have different behaviours for

a different category of his/her personality type. It is important to emphasise here that there are no categories superior over others. However as already mentioned, these categories may indicate better performance in some kinds of situation. Surveys have been conducted to study MBTI personality type ratios of software developers [5-9]. However, few references are available related to Latin-American software professionals.

LITERATURE REVIEW

The software industry has become a major force in society. It has, in fact, generated a great deal of discussion as to the unique contributions of professionals engaged in software engineering's many sub-disciplines. Specialties within software engineering today are as diverse as in any other profession. The term, software engineer, encompasses a broad range of positions, such as system and data analysts, programmers, project managers, help desk personnel, and others involved in the planning, analysis, design, construction and deployment of software systems [10]. Software development is comprised of separate and distinct stages, such as: system analysis, design, programming, testing and maintenance. It may be that certain personality dimensions affect one stage but not others, or affect certain stages in different fashions [3].

Empirical studies have investigated the relationship between MBTI and software engineers; Sitton and Chmelir list some stereotypes of programmers and what it is that attracts them to the computer field [11]. Their study paints a picture of creative professionals irreverently solving complicated problems, unencumbered by routine and humdrum details; however, they give no specific statistics regarding their findings. Further, Bush and Schkade tested 58 professionals involved with scientific programming in an aerospace company [12]. They found ISTJ (25%) to be the most common personality type, with the second most common type being INTJ (16%), and ENTP (9%) being the third. They also found thinking (74%) and judging (70%) to be very common.

Buie took a sample of 47 computer professionals employed by a private company under contract with NASA and who were performing work on orbital-related software [13]. The most frequent personality types were ISTJ (19%), INTP (15%) and INTJ (13%), with those three collectively accounting for nearly half the sample; ESFJ (0%), ISFP (0%) and ENTP (0%) were particularly under-represented. The hypothesis that scientific programmers would tend toward an over-representation of Is, Ns, and Ts was supported.

Smith dealt with 37 systems analysts at a large insurance company [14]. The most frequent types in the sample were ISTJ (35%) and ESTJ (30%). From the results, there were slightly more introverts (57%), but there was also a heavy bias towards the sensing (81%), thinking (89%) and judging (86%) types. Interestingly, the four NF combinations were not present at all in this small sample. Larger and more diverse samples would allow more comprehensive data and definitive conclusions.

Lyons surveyed 1,229 software professionals from more than 100 companies, including insurance companies, financial institutions, utilities and hardware manufacturers [15]. He too found ISTJ (23%) to be the most common type, INTJ (15%) to be the second and INTP (12%) to be a close third, noting that these three personality types composed 50% of his sample. He found thinking (81%) and judging (65%) types to be in the majority; furthermore, he also found that 67% of his subjects were classified as introversion types. He was the first to observe that R&D organisations and companies that do a lot of state-of-the-art development attract and hire more Ns than Ss. The opposite occurs in large organisations, where the bulk of the work involves maintaining and enhancing production software systems.

Hardiman has claimed that the MBTI may be the best predictor of who would become a competent programmer [16]. He observed that the majority of good software engineers were ENTJ, INTJ, ESTJ, ISTJ, ISFJ, and ENTP, in brief, mostly NTs and SJs. He implies that NF types tend to have trouble with the sequential and process-oriented thinking required to design and implement software.

Capretz investigated the profile of a group of 100 software engineers (80% male and 20% female) who study in private or public universities, or work for the government or for software companies [6]. They were all productive and motivated software engineers and were selected to participate in this study based on their occupation. All were administered the MBTI (Form G) to assess their personality types. The largest single type found among the subjects was ISTJ. Considering the dominance of introverts in the software field, he concludes, ...*This may partially explain why software systems are notorious for not meeting users' requirements*.

RESEARCH METHODOLOGY AND ANALYSIS

In this study, 103 Cuban software engineers were surveyed who included students (upper-level Informatics Sciences Engineering courses) and professors of the University of Informatics Sciences in Havana, Cuba. Both, the students and professors were directly involved in software projects. The MBTI instrument (Form M, Spanish language version) was used to identify their personality types. They were invited to take the MBTI measure at the university campus. The criteria to select the students to take part in this survey included academic performance, skill and interest in software development, as well as a recommendation by their teachers. Grade Point Averages (GPAs), however, were not taken into account. The ratio between genders was approximately even, with 48% males to 52% females in the sample. The students' age range was between 22 and 23, whereas the professors' age range was between 22 and 27 years.

RESULTS

The personality type distribution is summarised in Table 1 and Table 2 below. It can be observed that among respondents, the number of extroverts (63%) were almost double the number of introverts (37%). Similarly, sensing (71%) dominates over intuitive (29%), thinking (75%) over feeling (25%), and judging (61%) over perceiving (39%). A similar outcome was observed when these results were compared with some of the previous studies [5][6][17]. The survey confirms the over-representation of Ts and Ss with 75% and 71% respectively, as well as the under-representation of Fs and Ns with 25 % and 29 % respectively, as shown in Table1.

Table 1: MBTI distribution among Cuban software engineers (n = 103).

Type	Quantity	% Over Total
E	65 51% males 49 % females	63
I	38 42 % males 58 % females	37
S	73 42 % males 58 % females	71
N	30 60 % males 40% females	29
T	77 55 % males 45 % females	75
F	26 31 % males 69 % females	25
J	63 48 % males 52 % females	61
P	40 48 % males 52 % females	39

Considering the responders' gender, there is no significant differences among Es; or between Js and Ps, which have the same distribution, as shown in Table 1. Interestingly however, Ns and Ss show the opposite behaviour (60% males, 40 % females in Ns; 42% males, 58% females in Ss). Similarly, this survey shows a relatively higher percentage of males in Ts and a higher percentage of females in Fs.

Unfortunately, there is no registered MBTI personality type data available about the general Cuban population with which to compare these results; still, the research indicates the pattern observed among Cuban software engineers. Out of 16 MBTI combinations, the ESTJ personality type has the topmost representation of 26% among the surveyed Cuban software engineers, as shown in Table 2.

This is followed by ESTP with 13%, and then ISTJ with 10%. Together, ESTJ, ESTP and ISTJ represent half of the sample population. Among the respondents, INFJ and INFP were the least represented, both having 1% followed by ISFP, ENTP and ESFJ with 2%.

Table 2: Cuban software engineers' representation for the 16 MBTI combinations.

ISTJ 10%	ISFJ 7%	INFJ 1%	INTJ 6%
ISTP 5%	ISFP 2%	INFP 1%	INTP 6%
ESTP 13%	ESFP 6%	ENFP 3%	ENTP 2%
ESTJ 26%	ESFJ 2%	ENFJ 3%	ENTJ 7%

It is worth noting that the overrepresentation of ESTPs is in contrast with the majority of previous studies in this domain. On the other hand, ISTJs exhibit a lower value when compared with other studies [5][6][17]. Furthermore, in this study, a moderate rise in ESFPs was observed, as well.

The sampled Cuban software engineers' temperament distribution also has been recorded and is reflected in Table 3. The dominant temperament is ST with 54%; although TJ (49%), ET (49%), ES (48%) are well represented also. NF is the least represented temperament with only 9%. These values, however, are quite similar to the results of previous studies, where STs and TJs have been noted as abundant and NFs as scarce [2][4][6][8][14][17].

Table 3: Cuban software engineers' temperament distribution.

Temperament	Quantity	%	Temperament	Quantity	%
SP	27	26	TJ	50	49
SJ	46	45	TP	27	26
NT	21	20	FP	13	13
NF	9	9	FJ	13	13
IJ	24	23	IN	14	14
IP	14	14	EN	16	16
EP	26	25	IS	24	23
EJ	39	38	ES	49	48
ST	56	54	ET	50	49
SF	17	17	EF	15	15
NP	13	13	IF	11	11
NJ	17	17	IT	27	26

This study shows STs (Sensing and Thinking) and TJs (Thinking and Judging) are the dominant temperaments among the Cuban subjects. According to MBTI, TJs manifest in an orderly and methodical way with decisions based on a logical and objective analysis, whereas STs manifest in a less methodical but more creative and practical manner.

CONCLUSIONS

Although 20 years ago software developers (systems analysts and programmers) had the lowest need for social interaction on the job, at present, human resource professionals responsible for hiring software engineers state that in addition to knowledge in applied computing and business, it is also very important that software professionals have the capacity to learn, ability to work in teams, oral and written communications skills and an orientation toward health and well-being. In short, adaptability, communication and stress management are seen as key skills for software engineers nowadays. Yet, such skills are not developed through logic and algebraic reasoning alone; they involve *soft areas* of intuition, feelings and senses.

In this study, the most prominent personality type was a combination of extroversion, sensing, thinking and judging. For example, ESTJs are known as being practical and realistic individuals; they lead people and make things happen and, thus, are more likely to rise to management positions. At present, planning, management and analysis are more dominant tasks than programming, and client-developer interaction is also required. Even selected software development methodologies tend to be agile, which means that programmers must be communicative and receptive. It is, therefore, possible that future studies will show extroverts more widely distributed than introverts in the software industry.

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Experiential learning in engineering education: a case study at NIU

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ABSTRACT: The field of engineering education has gone through several re-engineering efforts under various names. Some of the popular names in the past have been *sustainable engineering* and *concurrent engineering*. While each of these names has a different flavour to it, the underlying principle of effective engineering education has been its ability to provide practical and functional learning opportunities to students. Experiential learning, which encompasses all types of practice-based learning opportunities, is the founding principle of a successful engineering education model. Of Northern Illinois University's seven colleges, the College of Engineering and Engineering Technology (CEET) is the youngest and smallest. The College is 25 years old, and has focused on its position statement of *Theory Meets Practice* to create a niche for its programmes in engineering and technology. Outlined in this article is the unique strategy adopted by the College to provide experiential learning opportunities to its students.

Keywords: Engineering research, industrial partnerships, experiential learning, engineering

INTRODUCTION

Northern Illinois University's (NIU) College of Engineering and Engineering Technology (CEET) has created productive partnerships with almost 200 area companies, and the College continues to address issues of economic development, innovation, and workforce training for its industrial partners. These industrial partners, in addition to serving on various advisory boards, are active in providing research opportunities to students and faculty, and also sponsor design projects for CEET students.

Placement of students graduating from the College always has been high, and industries consistently return to hire additional graduates. However, in the current economic climate, companies are finding it hard to employ full-time engineers, due to the associated costs and uncertainty of making a long-term commitment to employees.

Also, there is a high percentage of international students enrolled in the College's graduate programmes. It has been observed that companies want to assess the quality of these graduates before giving them full-time employment and applying for the H-1B visa that is required for international students to be able to work in the country after graduation. International students also have an opportunity to pursue work opportunities under the Optional Practical Training (OPT) model, which entitles them to have work privileges as authorised and approved by the immigration and university policies.

These students need an opportunity to demonstrate their skills and impress their prospective employers in order to gain future full-time employment. Their chances of success are enhanced by them getting involved in activities that blend theoretical knowledge with real-life practical experiences. An initiative is described in this article that enhances problem-based experiential learning for all participants, thereby increasing their functionality [1].

The College also has an active research programme for the undergraduate students. These students can enhance their skills by participating in research-oriented assignments in business and industrial sectors. The model described below addresses all of the above concerns and strengthens the relationships between academia and the business sector, which is an important ingredient for area economic development. Also, there is an expressed need by the industrial sector for the graduating engineers to be exposed to experiential learning opportunities. Experiential learning not only makes the students technically functional, but also enables them to be better engineers as a result of their understanding of the real-life content of their engineering education [1-3].

ENGINEERS IN RESIDENCE (EIR) PROGRAMME

The Engineers in Residence (EIR) programme was conceptualised two years ago, while the economy was in a downturn, and students were struggling to find employment opportunities. The model was a way to provide low-cost research expertise to industries without burdening those companies with benefits and other costs usually associated with hiring a new employee. The model is based on providing 20 hours a week of work, to be concentrated upon a research area sponsored by the company. The student is usually on the university payroll. The company is charged a lump sum cost for a nine-month appointment. The assignment usually coincides with the academic year, but can be negotiated to coincide with the calendar year, depending upon the mutual agreement between the employee and the employer. It has been observed that after one year, many students participating in the EIR model become potential full-time employees for the company upon graduation. The company gets an opportunity to evaluate the skills of the EIR candidates and feels increasingly comfortable in hiring a person who may require further support from the company to process immigration formalities for international students.

Every student is assigned a faculty advisor, enabling them to go above and beyond their own personal skills to provide research solutions to the problems indicated by the company. If needed, the department chair may also provide assistance. The College's own facilities, comprised of 43 state-of-the-art laboratories, and about 120 engineering software programs, are also made available to the student to do his or her work. The research areas, which coincide with faculty expertise, are compiled and shared with the prospective companies, in order for them to focus their interest in areas of mutual expertise. The students work on real-life issues and seek advice from their peers, mentors and faculty advisors to enrich their theoretical knowledge with practical, hands-on experience, thereby making them better engineers [2][4].

SAMPLE OF CURRENT PROJECTS

Examples of some of the College's EIR projects are described below. The purpose is to understand the scope of work and technical expertise required to enter into EIR agreements. Also, the active involvement of industry in assessing and evaluating the project enhances its relevance and efficiency [5]. The projects highlight the skill sets expected of students who participate in EIR projects.

Project 1: To Analyse the Quotation Process and Production System

This company specialises in cold heading, hot forming and forging tooling. The company has been supplying steel and carbide tooling to the fastener industry for more than 28 years. It has CNC (computer numerical control) machines to perform turning and milling operations, and grinding, EDM (electrical discharge machining), and other tooling capabilities are available in-house.

Project Objectives

The objective of this research study was to optimise the quotation process. In order for the company to be profitable, it is necessary to develop accurate and timely quotations to attract new customers, and to provide excellent service to continuing customers. By under-quoting, the company may incur loss; by over-quoting, the company can lose a customer. The primary objective of this study was to streamline the existing quotation process. To prepare a good quote, the time standards for each operation, cost of individual components from the BOM (bill of materials), labour costs, and other pertinent information were assessed and analysed.

Project Activities

Through preliminary discussions, it was confirmed that the time standards used in the *as-is* case are questionable (or can be improved). Consequently, the first major project task was to develop time standards for operations involved at the company and validate these standards with their team. In order to accomplish this, the project team studied all the operations, product types or families, material used, etc. A detailed process map for each product type or family was developed. Time standards were then established based on the process map. Both the team from NIU and the company worked closely to agree upon the standards and the process maps.

Upon completing the first task, the following steps were taken to streamline the quotation process:

1. Developed business process flow map for the entire quotation process (from initial customer inquiry to order confirmation);
2. Identified methods or procedures to shorten the time to prepare quotes;
3. Tested the new procedures and verified if they were viable to implement.

In addition to streamlining the quotation process, this research also attempted to investigate current procedures followed for scheduling and product changeovers. The objectives of these initiatives were to improve resource utilisation, shorten downtime of the resources, and minimise waste.

Project Deliverables

The project deliverables included documentation of all the procedures, and, if necessary, the training of appropriate personnel to follow the new procedures.

Project 2: Implement the Throughput Related Process Improvements for the Assembly Operation Area

Project Objectives

The ultimate objective of this project was to study the two main assembly lines, and to redesign current processes that allow improvements in throughput. The research work included process mapping, time standards, line balancing, 5S (workplace organisation methodology), lean manufacturing, etc. This time study served as the input for calculating time standards and performing analysis to improve performance, maximise efficiency, reduce costs, and to increase throughput.

The primary objectives of the project were to:

1. Develop value stream mapping for the area under study documenting the current state.
2. Perform a complete time study for the assembly area.
3. Analyse throughput and line balancing for the assembly line.
4. Provide recommendations for improvement.
5. Develop and document a future state process map.

Project Activities

The planned activities undertaken by the NIU team, with support from the supervisors of assembly area, were to:

1. Develop a value stream map to document the current state of the assembly process.
2. Perform a time study and collect data.
3. Calculate time standards.
4. Analyse throughput and line balancing.
5. Perform cost analysis for alternatives of improvements.
6. Develop a future state process map that documents improvements.
7. Write a technical report and prepare a presentation.

Project 3: Implement Quality Management Systems for a Machine Tool and Production Company Serving OEM (original equipment manufacturers) and Volume Users

Programme Objectives

The primary objective of this research endeavour was to prepare the company to develop a quality management system, which would help them to get certified in AS9100 and ISO/TS 16949. The AS9100 is a set of quality management system requirements for design and manufacture of aerospace products. Quality and reliability are critical factors for components manufactured for the aerospace industry. An effective quality management system is essential to minimise risks and to provide reliable products and services to the aerospace industry.

The aim of ISO/TS16949 is to align automotive quality standards in the United States and other countries within the global automotive industry. The project included developing quality standards for their management with a general theme of optimisation and continuous improvement. The project also reviewed the supply chain and production systems.

Programme Activities

In order to accomplish the primary objectives, tasks were undertaken to:

1. Review current system and procedures.
2. Conduct gap analysis.
3. Develop an action plan to close the gap.
4. Create procedures/processes.
5. Recommend changes through a formal report and offer to participate in the implantation process.
6. Audit changes and revise as required.
7. Provide recommendations and appropriate training.

The final deliverable of the project was to develop standard operating procedures to follow different processes in the facility. During the course of this project, many process improvement opportunities were explored, implemented and reported.

Project 4: A Systematic Approach to Assessing Energy Consumption for a Company

Programme Objectives

The primary objective of the proposed research project was to analyse the energy consumption of different furnaces in the facility. Energy consumed is a function of the number of parts loaded in a batch, total weight of the parts in the batch, material composition, customer specifications, the profile used, etc. Some furnaces use electricity, while others use gas to heat. The project studied both electrically and gas heated furnaces. When some furnace types were available in multiple identical units, one furnace of every type was studied. By understanding how energy is consumed by each furnace, the company was in a better position to prepare accurate quotes. Prior to the project, the company did not have a mechanism to measure the energy consumed by each furnace and adopted an *ad hoc* approach to preparing quotes. The findings of this study enabled the company to assess the energy consumed and helped them to prepare accurate quotes, thereby rendering them more profitable and productive.

Project Activities

The following activities were undertaken to complete the proposed project:

1. Understand the flow of materials in the facility, different heat treatment processes, different types of furnaces, etc.
2. Identify the set of furnaces that should be studied, and prepare a priority list to follow.
3. Observe the profile, cycle times, and pertinent details for several batches of orders.
4. Conduct interviews with practitioners to understand what they might think affects the cycle time.
5. Identify the factors that affect the amount of energy consumed.
6. Identify appropriate energy meters to collect data on energy consumed for several orders.
7. Validate and verify the results with historical data, where appropriate.
8. Discuss the findings with practitioners from the company and repeat the study for fine-tuning, if necessary.

The final deliverable was a report outlining both the cost per unit of energy consumed for different furnaces, and a plan for optimising the costs. The above information provided a sample of the kind of projects CEET accepts under the EIR programme. The purpose was to establish a mutually beneficial relationship with the industry partners and to stimulate research and innovation in a cost-effective manner.

INDUSTRIAL FEEDBACK

The College has received very positive feedback from companies who have partnered with CEET for the EIR programme. A sample of comments from the several companies involved in EIR is below:

- The Chief Financial Officer of one of the participating companies expressed his *strongest support* for the cost-effectiveness of the EIR programme: *The [EIR] student has identified processes and procedures to reduce quote time turnaround by 38% ...the savings to the company is approximately US$27,000 per year*.
- The Vice President of Manufacturing for another participating company said that *the Engineering in Residence programme was EXACTLY what we needed*. She called the participating EIR students *professional* and *mature*, saying that they *have fit with the company better than any of us had hoped*.
- The Distribution Director for a participating company said that he likes *the fact that it brings the business community together with the college community*, and that the EIR students are *respectful, intelligent and understanding*. The Industrial and Automation Supervisor at the same company said that the *[EIR] interns have provided us great opportunities to take projects to a higher level.*

The comments substantiate the ability of the College's faculty and students to handle challenging research assignments sponsored by industry, and also reflect a mindset of industry/academia partnership, which will be critical to economic development and sustainability. Upon talking to the students, it was established that they found their experience to be fulfilling. They better understood the concept of applied research and were appreciative of the fact that faculty were available for consultation when needed. Some of the students participating in the programme felt they were better prepared for their careers and that they had a competitive advantage in their job search. Several of the students perceived EIR as an ideal vehicle for their final launch into the work sector. Also, the increased confidence and sustained motivation were some of the other attributes seen in participating students.

SAMPLE MEMORANDUM OF UNDERSTANDING (MOU)

The agreement is necessary to address intellectual property issues associated with the EIR projects and must be approved by the legal entities of the participating members (CEET and the sponsoring industry).

AGREEMENT

THIS AGREEMENT is made between the Board of Trustees of Northern Illinois University, hereinafter called the "UNIVERSITY," with principal offices at DeKalb, Illinois 60115, and [COMPANY NAME], hereinafter called the "SPONSOR," with principal offices at [ADDRESS].

WITNESSETH:

WHEREAS, the SPONSOR and the UNIVERSITY desire to enter into an agreement pertaining to a Project investigation in accordance with the Statement of Work in Appendix A; and

WHEREAS, the investigation is to be funded by the SPONSOR and carried out by the UNIVERSITY under the terms and conditions specified herein; and

WHEREAS, the performance of such investigation is of mutual interest to the SPONSOR and the UNIVERSITY, and is consistent with the instructional, scholarship and research objectives of the UNIVERSITY as a non-profit, tax-exempt educational institution.

NOW, THEREFORE, in consideration of the mutual covenants and promises herein contained, the parties hereby agree as follows:

1. STATEMENT OF WORK

The UNIVERSITY agrees to use reasonable efforts to perform the project as described in the Statement of Work, which is incorporated herein and attached as Appendix A. These efforts are hereinafter called the "Project". The UNIVERSITY shall perform this effort consistent with reasonable standards of professionalism applied in related fields. The Project is titled, "*Lean' Process Improvement for Medical/Surgical Unit*" at [COMPANY NAME].

2. PRINCIPAL INVESTIGATOR

The Principal Investigator assigned by the University for directing the performance of the Project is [FACULTY NAME]. If for any reason the Principal Investigator withdraws from serving as principal investigator, the UNIVERSITY and the SPONSOR shall endeavor to agree upon a successor. If the parties are unable to agree upon a successor, SPONSOR shall have the right to terminate this Agreement in the manner provided in the paragraph 9 entitled Termination.

3. PERIOD OF PERFORMANCE

The work shall be performed during the period from [DATES]. This date may be extended under the same terms or such other terms as may be mutually agreed upon.

4. COST OF RESEARCH

The SPONSOR agrees to pay the UNIVERSITY the fixed sum of [SAMPLE PRICE] for the performance of this Project. Payments are to be made in accordance with the following schedule:

1. Upon execution: [PRICE].
2. Thereafter, as follows: [PRICE] within thirty (30) days after delivery of the final product.
3. The UNIVERSITY shall retain title to equipment and all other items purchased with funds provided by the SPONSOR.

Checks are to be made payable to Northern Illinois University.

The UNIVERSITY is not obligated to expend any other funds on the Project, and the SPONSOR is not obligated to pay the UNIVERSITY in excess of the above stated amount.

5. RIGHTS IN WORK PRODUCT

All original Project results, data, records and work product generated by the UNIVERSITY under this Agreement, including all tangible and intangible property, shall be owned by the UNIVERSITY in accordance with UNIVERSITY policy.

6. INVENTIONS AND PATENTS

A. The UNIVERSITY shall own all inventions, discoveries, and other developments hereafter called "Inventions", the UNIVERSITY generates under this Agreement.

B. The UNIVERSITY shall disclose in writing any inventions resulting from the Project to the SPONSOR at the same time as the Principal Investigator discloses them in writing to the UNIVERSITY personnel responsible for patent matters. The disclosure to the SPONSOR shall be in the form of a written report and shall identify this Agreement and the Principal Investigator. The report shall be sufficiently complete in technical detail to convey a

clear understanding, to the extent known at the time of the disclosure, of the nature, purpose, operation, and the physical, chemical or biological characteristics of the Invention.

C. If the SPONSOR directs that a patent application or application for other intellectual property relating to the Invention be filed, the UNIVERSITY shall promptly prepare, file, and prosecute such U.S. and foreign application(s) in the UNIVERSITY'S name. The SPONSOR shall bear all costs incurred in connection with such preparation, filing, prosecution, and maintenance of U.S. and foreign application(s) which are owned by the UNIVERSITY. The SPONSOR shall cooperate with the UNIVERSITY to assure that such application(s) will cover, to the best of SPONSOR'S knowledge, all items of commercial interest and importance.

D. If the SPONSOR elects not to exercise its option as described below or decides to discontinue the financial support of the prosecution of maintenance of the protection, the UNIVERSITY shall be free to file continued prosecution of or maintain any such application(s), and to maintain any protection issuing thereon in the U.S. and in any foreign country at the UNIVERSITY'S sole expense, without further obligation to SPONSOR.

7. GRANT OF RIGHTS

A. The UNIVERSITY hereby grants the SPONSOR a royalty-free, non-exclusive license to use the Invention within its own organization for any noncommercial purpose.

B. The UNIVERSITY hereby grants the SPONSOR the first option, at the SPONSOR'S sole election, for either (a) a non-exclusive, royalty-bearing license to use the Invention for any purpose except sublicensing, or (b) an exclusive, royalty-bearing license with a right to sublicense. Terms and conditions of these licenses are to be negotiated in good faith and agreed upon between the UNIVERSITY and the SPONSOR. Provided the SPONSOR has participated in bearing patent expenses as described in Article 6 above, this option shall extend for a period of sixty (60) days from the termination date of this Agreement.

C. In the event that the SPONSOR acquires an exclusive license or right under subsection B of this Article, the UNIVERSITY will retain the right to continue to use any such Inventions within the UNIVERSITY for any noncommercial purpose.

8. CONFIDENTIAL INFORMATION

A. Prior to disclosure of Property Information to University by SPONSOR, SPONSOR shall notify Principal Investigator of its intent to disclose Proprietary Information. The Principal Investigator shall have the right to decline receipt of said information. Said Proprietary Information shall be sent only to Principal Investigator. Information disclosed orally shall be considered. Proprietary Information is only if such information is stated to be so at the time of disclosure and is confirmed in writing as being Proprietary Information within thirty (30) days after the initial disclosure.

B. Each party to this Agreement agrees to treat Proprietary Information received from the other with the same degree of care with which it treats its own Proprietary Information and further agrees not to disclose such Proprietary Information to a third party without prior written consent from the party disclosing Proprietary Information.

C. The foregoing obligations of non-disclosure do not apply to Proprietary Information which:

(a) Was known to the recipient prior to the disclosure hereunder;
(b) Was received from a third party not under and obligation of confidence to recipient;
(c) Is in the public domain at the time of disclosure hereunder or subsequently entered the public domain without the fault of the recipient;
(d) Has been independently developed by an employee of recipient that has not had access directly or indirectly to Proprietary Information, and recipient can substantiate any claim of independent development by written evidence; or
(e) Is required to be disclosed by law.

D. Unless otherwise agreed to in writing, neither party hereto shall have any obligation of confidentiality under this Agreement after the earliest of either the fifth anniversary of the conclusion of Period of Performance or termination in accordance with Article 9.

9. TERMINATION

This Project may be terminated by either party upon thirty (30) days written notice. In the event of termination by the SPONSOR, the UNIVERSITY will be reimbursed for all costs incurred and all non-cancellable commitments at the time of termination. In the event of termination by the UNIVERSITY, any unexpended or unobligated balance of funds advanced by the SPONSOR shall be refunded to the SPONSOR. The provisions of Articles 5, 6, 7 and 10 shall survive any termination of the Agreement.

10. USE OF THE NAME OF THE PARTIES

Neither the SPONSOR nor the UNIVERSITY shall make use of the existence of the Agreement, nor use the other's name or the name of any member of its staff, for publicity or advertising purposes except with the consent of and to the extent approved by the other party. For the UNIVERSITY, such approval will be obtained from the Director, Office of Sponsored Projects.

11. PUBLICATION

The UNIVERSITY shall have the right to publish or otherwise disclose the results of this Project, provided that the Principal Investigator first provides the SPONSOR with a copy of the proposed publication at least thirty (30) days in advance of submission for publication. The SPONSOR shall have thirty (30) days after the receipt of the publication or presentation to review it. The Principal Investigator shall modify said publication in order to comply with reasonable requests by the SPONSOR. Upon notice by the SPONSOR that the SPONSOR reasonably believes a patent application relating to an Invention should be filed prior to the publication or presentation, the SPONSOR can request the UNIVERSITY to delay and the UNIVERSITY agrees to delay submission of the publication or presentation for up to sixty (60) days from the date the SPONSOR so notifies the UNIVERSITY or until a patent application or applications are filed, whichever comes first.

12. REPORTS

A final report will be submitted to the SPONSOR by the Principal Investigator within one hundred twenty (120) days of the termination of this Agreement.

13. WARRANTIES AND INDEMNIFICATION

THE UNIVERSITY MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, REGARDING ITS PERFORMANCE UNDER THIS AGREEMENT, INCLUDING BUT NOT LIMITED TO THE MARKETABILITY, USE OR FITNESS FOR ANY PARTICULAR PURPOSE OF THE PROJECT RESULTS DEVELOPED UNDER THIS AGREEMENT, OR THAT SUCH RESULTS DO NOT INFRINGE UPON ANY THIRD PARTY'S PROPERTY RIGHTS. The SPONSOR agrees to indemnify and hold harmless the UNIVERSITY and its employees and agents against any and all costs, damages and expenses, including attorney's fees, arising from any claims, damages and liabilities asserted by third parties arising from the SPONSOR'S use of said results.

14. ASSIGNMENT

Neither party shall assign its rights under this agreement without the prior written consent of the other party. Notwithstanding the foregoing, University hereby consents to the assignment of this agreement by Sponsor to any present or future wholly-owned affiliate of Sponsor or to any successor in interest of the entire business of Sponsor as a result of a merger, consolidation or purchase as long as the assignee expressly accepts in writing all the obligations and responsibilities of Sponsor under this agreement.

15. GOVERNING LAW

This agreement shall be interpreted and construed in accordance with the laws of the State of Illinois. This agreement is subject to all applicable rules and regulations of the Board of Trustees of Northern Illinois University and the laws of the United States and the State of Illinois.

16. ENTIRE AGREEMENT

This agreement contains all the terms and conditions agreed upon by the parties hereto, and no agreement, oral or otherwise, regarding the subject matter of this agreement shall be deemed to exist or be binding upon any of the parties hereto, unless in writing executed by the parties hereto.

IN WITNESS WHEREOF, the parties have executed this agreement on the dates indicated below by representatives authorized to make such commitments on behalf of the respective party.

BENEFITS OF THE EIR PROGRAMME

The EIR programme provides several benefits to students. It enhances their ability to be more functional and hit the ground running at a job, from day one. This programme has enhanced the image and reputation of NIU's College of Engineering and Engineering Technology by substantiating the true partnership concept to the industry. This programme has enabled the students and faculty at CEET to work with companies in addressing their research priorities and needs at relatively subsidised rates. Also, the programme has increased the experiential learning aspect of the academic programmes by enabling students to solve real-life problems and by engaging in experiential learning [6].

Also, the students experiencing research-based learning are better prepared for a global economy [7]. The following are the key benefits of the programme:

1. Experiential learning
2. Exposure to real-life work environment
3. Topic for master's thesis
4. Increased motivation and confidence
5. Faculty/Industrial collaboration opportunities
6. Employment opportunities
7. Increased funding for College's departments
8. Financial support to the College's students.

CONCLUSIONS

The EIR programme has enjoyed tremendous success since its launch two years ago. All of the stakeholders of the College, including government partners, industries, students and alumni, have endorsed the programme at the highest level. Students are excited about the experiential learning aspect of the programme and value the connections made during the experience. The departments are pleased with the funding associated with the programme and faculty are elated with the research opportunities and the chance to earn extra income. This is a successful venture that brings industry and academia together to promote research and innovation.

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BIOGRAPHIES

Dr Omar Ghrayeb is the Associate Dean of Outreach and Undergraduate Programs of Northern Illinois University's College of Engineering and Engineering Technology. He works closely with the industrial sector and spearheads the EIR programme. He is committed to promoting experiential learning as part of engineering education and works with several companies in the area to bring real-life projects into the classroom. His expertise is in process innovation and production planning.

Dr Promod Vohra is the Dean of Northern Illinois University's College of Engineering and Engineering Technology. His commitment to applied research and global engineering education is reflected in his work and philosophy. Dr Vohra has widely published and serves on several national and international committees and boards. He believes the engineering profession must act as a catalyst of innovation and create a new economy for the globe.

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