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KNOWLEDGE DEVELOPMENT THROUGH REFLECTIVE PRACTICE

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Abstract

This paper examines the development of knowledge through reflective practice and more specifically the development of the author's knowledge as a result of engaging in reflection on an issue in the field of the author's research interest. The author commences by consulting and analysing existing published research on reflective practice. The paper sets out the theory of reflective practice as documented by eminent authors in the field. The author addresses the concept of action learning and frames this process within Kolb's (1976) experiential learning model, in an attempt to formulate a framework whereby his own research focus can be developed. The authors own understanding of reflective practice is addressed in the context of a documented reflective response to a professional issue in his current role as a lecturer in the School of Real Estate and Construction Economics, in Dublin Institute of Technology (DIT). Although this issue is not necessarily applicable to the author's research interest for his doctoral study - this experience including a detailed literature review on reflective practice, assisted the author in outlining and developing a focus to his research topic through reflection. The author's research topic (whole life cycle costing) emerged from reflecting on the time consuming calculations and methodologies that are required to be implemented for whole life cycle costing on construction projects. Through the process of documented reflection the author was able to identify an issue in whole life cycle costing that will be the focus of his preliminary literature review for his doctoral research.

Keywords: Reflection, knowledge development, life cycle costing, reflective practice.

1 INTRODUCTION

This paper will commence with an examination of the theory of reflective practice and how the review of literature on the subject helped shape a framework whereby the authors own understanding of the process was enhanced and developed. The author will proceed to outline his first documented experience of reflective practice in his professional life as a lecturer in the School of Real Estate and Construction Economics at Dublin Institute of Technology (DIT), while studying at DIT's Learning and Teaching Centre. Using the models and concepts outlined during the authors literature review on reflective practice and the experience gained from engaging in reflection in his professional life – the author will critically reflect and review an area of his own practice and outline the process by which his research interest has emerged from reflection on a particular issue within this area.

2 THEORY OF REFLECTIVE PRACTICE – THE CONCEPTS AND THEORIES OF REFLECTIVE PRACTICE

2.1 Reflective Practice

“No man ever sets himself about anything but upon some view or other, which serves him for a reason for what he does; and whatsoever faculties he employs, the understanding with such light as it has, well or ill in-formed, constantly leads; and by that light, true or false, all his operative powers are directedTemples have their sacred images and we what influence they have always had over a great part of mankind. But in truth the ideas and images in men's mind are the invisible powers that constantly govern them, and to these they all, universally pay a ready submission. It is therefore of the highest concernment that great care should be taken of the understanding, to conduct it aright in search of knowledge and in the judgements it makes” John Locke (1632-1709).

John Locke (1632-1709) as cited in Dewey (1933, p.21) outlines the importance of thought in the pursuit of action and doing. Locke implies that in order to analyse action we must understand our thought process. Dewey, one of the seminal authors on reflective practice (1933, p.29), uses the

statement above as a vehicle to outline the importance of thought and the need to train our thought process so we are "elevated above the brute". Using our conscious thought process for judgement and reflection on our action provides man with a tool which can override the reactive and instinctive thought process of Dewey's 'brute'. According to Hinett (2002, p.2) with the aid of a simple prompt question such as "what might I do better next time?" or "what I could do differently?" we have the potential to draw on the past and present and direct ourselves into a better future. Asking questions such as these stimulates students and practitioners to reflect on past experiences. Biggs (1999) provides an excellent metaphor for reflection when he outlines the difference between the reflection in a mirror which he describes is "an exact replica of what is in front of it" and reflection in practice "which gives back not what it is, but what might be, an improvement on the original". Moon (1999, p.4) seems to agree with Biggs's simile as she states that "reflection seems to suggest more processing than would occur when simply recalling something", the insinuation of considering something other than accepting what is 'just in front of you!'.

In relation to adjusting our actions based on an unsuccessful experience to improve the probability of the future adjusted action being successful, learning from doing is not a recent documented concept and it is certainly not a new phenomena. Dewey (1933) suggests the fact we (man) have the ability to learn from our actions provides us with the responsibility to control our thoughts by education and understanding, because of its natural tendency to go astray due to social influences, animal instinct, and habits of thought.

Dewey (1933) and Schön (1983) are seen as seminal authors in the process of reflection and outlining how education and training in the natural human traits of curiosity, testing, exploring and suggestion increases the efficiency of human action. One of the premises that differentiates Schön's and Dewey's work is Schön's focus on the reflective practitioner. Schön sees practitioners as the purveyors of solutions to some of man's difficult social problems. Schön (1983, p.21) argues, what equips practitioners over and above the lay person with this responsibility is their application of "scientific theory and technique", focusing on what Dewey outlines as the "importance of training" and in the case of practitioners, training in their respective field.

Schön (1983, p.49-50) wrote that the workday of a professional practitioner depends on tacit knowing in action. Pete Mann (1998) in his article in the *Times Higher Education Supplement* describes tacit knowledge as the knowledge of the body, which he outlines, is the knowledge of know-how and learning while doing. Schön (1983, p.60-61) argues consistent action leads to a practitioners knowing in practice becoming more tacit, spontaneous and automatic. However he argues that conditioning through training can lead practitioners to miss opportunities to think about what they are doing to possibly improve their practice. Counteracting the possibility of Dewey's notion of practitioners becoming conditioned, Raelin (1997, p.565) states that practitioners should develop a reflective approach to learning and practice which leads them to become more sensitive to "why they performed in a certain way, the values being manifested, the discrepancies that existed between what was said and what was done and the way in which forces below the surface may have shaped actions and outcomes". The depth of reflection that Raelin has alluded to above has been commented on by a number of eminent authors such as Van-Mannen (1977) and Hatton and Smith (1995), prescribing a hierarchal classification structure to the rigor employed in reflection.

Van-Mannen (1977) as cited in Roberts (2008, p.3) sets out a hierarchical classification of three levels of reflection: "At the lowest level (technical), reflection would simply be an evaluation of efficacy of an action; the second level (practical) would see reflection on the goals and assumptions that underpin a particular action, whilst the highest level (critical reflection) would attempt to relate, and question the activity as part of its wider social, political and ethical context". Protor (1993) as cited in Moon (1999, p.59) also emphasises the critique element in reflective practice. On this view Protor is advocating the highest level of Van-Mannen (1977) hierarchy by "looking back" on issues and problems in "a critical way at what has occurred and using the results of this process, together with professional knowledge to tackle new situations". It would be necessary carrying out reflection at doctoral level that the researcher employs reflection to the highest level of Van Mannen's hierarchy. The author intends to outline reflection in a particular element of his practice below in order to frame the content of his research and he will endeavour to achieve critical reflection to the highest standard of Van-Mannen's scale.

Hinett (2002, p.2) citing Laurillard (1993) draws a distinction between mediated learning (aided by a teacher) and un-mediated learning (experiential). Hinett stresses that un-mediated learning gets to the heart of the reflective process as it outlines the process of learning something other than what is delivered or aided by the teacher. Hinett maintains reflection can enhance un-mediated learning by

providing a structure and framework to help us as reflective practitioners. One of the most famous of learning cycles is the structure originally illustrated in Kolb's (1976) paper '*Management and the Learning Process*'. Kolb's learning model demonstrates a four staged process of how reflection can assist in improving the learning process and how issues are reflected upon to form new concepts and theories, which are in turn used to provide solutions. The success of Kolb's learning model (as demonstrated in its frequent reference in many of the leading publications in reflective practice and action learning) is rooted in its recognition that reflective learning requires abilities that are polar opposites.

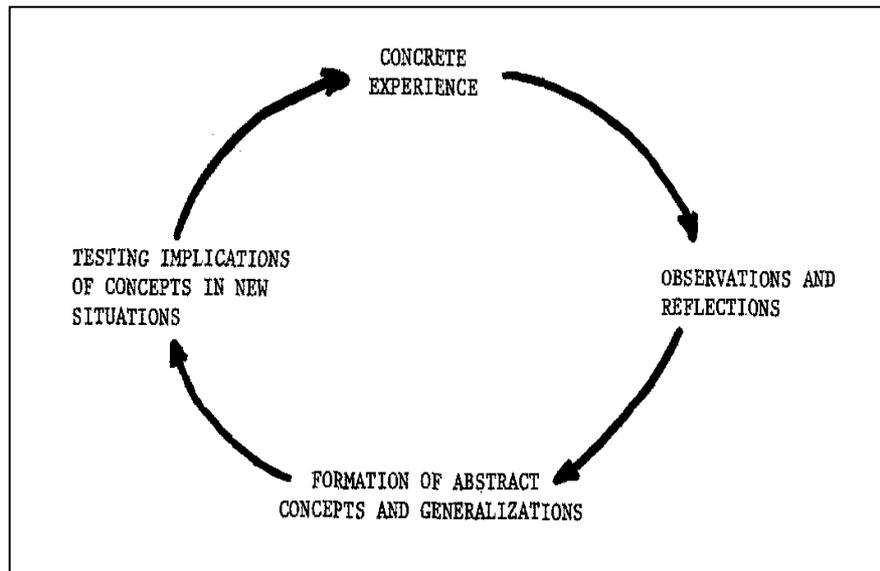


Figure 1 – Kolb's Experiential Learning Model, (Source, Kolb, 1976, p.22).

As outlined in figure 1 above, the model moves from experience to observation and reflection, to abstract conceptualisation and then to active experimentation. In the learning model Kolb (1976, p.22) outlines that "one moves in varying degrees from actor to observer, from specific involvement to general analytical detachment". No matter what background you come from or what learning style or strengths you possess – the model, according to Kolb encourages a set of learning abilities that provide practitioners with the tools to adapt and master the changing demands of his job and career.

2.2 Reflection and Action Learning

Schön as cited in (Roberts, 2008, p.2-3) argues that reflection is a key element of professional thinking, as it provides professionals with a tool to improve their practice rather than rely on some readily available predetermined course of action. Schön refers to this process of "reflection on action and reflection in action". Both terms suggest that reflection is closely bound with action.

The methodological concept of action learning was developed during the 1920's in the Cavendish Laboratory at the University of Cambridge by a group of research scientists who found that through collaboration in a structured setting, reflecting on both their successes and failures, they gained a deeper insight into how to proceed and act appropriately (Botham & Vick, 1998, p.5).

McGill (1995, p.11) describe action learning as "a continuous process of learning and reflection, supported by colleagues with an intention of getting things done.....action learning is based on a relationship between reflection and learning". They outline reflection as the essential ingredient linking past action and more effective future action. McGill outlines an action learning cycle similar to Kolb's 'experiential learning model', where the action learning process moves from reflection on a certain experience or experiences, to identifying patterns in those experiences and formulating plans for improvement through action. McGill describes the action phase as the most important phase, as failure to act on reflections and thoughts will lead to a situation where a practitioner will never quite know whether their ideas have worked. The Revens Centre which was housed at the University of Salford from 1995 to 2004 viewed action learning in a similar context to the definition outlined by McGill. The focus however in the Revens Centre was more on the collaborate process of learning through 'sets'. The centre provided an environment where practitioners could work alongside

academics through a focused learning approach which was linked to progressive action research (Botham & Vick, 1998, p.8). The link between action learning and research is evident in the theoretical model put forward by the centre in 1996, which provides a triangular interface between action learning and research.

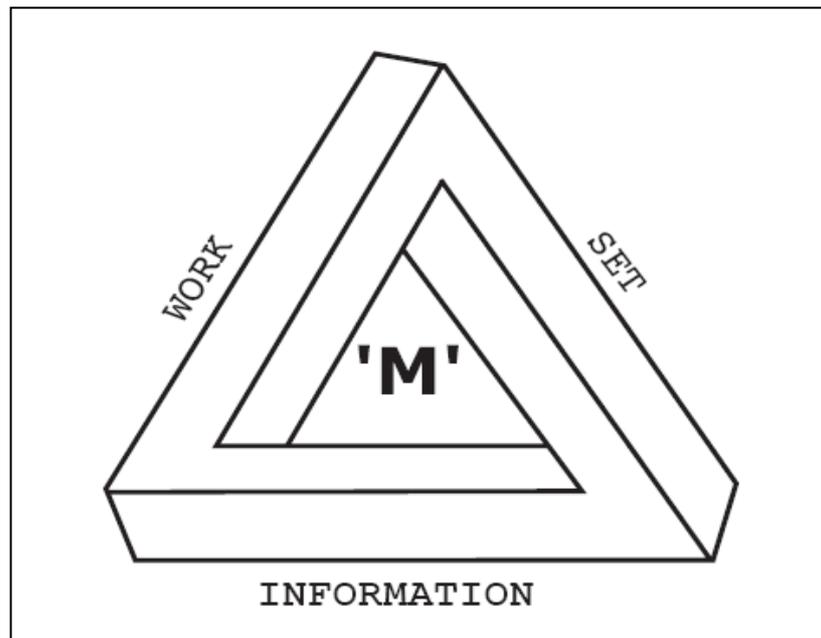


Figure 2 – Revens Centre Triangle, 1996 (Source, Botham and Vick, 1998, p.10).

Botham & Vick (1998, p.10-11) state that the model combines the reflection process from three perspectives. The first angle as seen in figure 2 above is focused on the learning experienced from an individual practitioners work, or the experiences gained by observing the actions of others engaged in a work setting. The second angle results from a process of participation within the learning set, where practitioners share their work experiences with the learning set members, with a view to challenging these experiences. The third angle focuses on the learning experiences gained from secondary research and thus closes a loop which focuses the participants' integrating a work based problem or issue through collaboration within a set and investigation of published materials.

McGill (1995, p.11) states that there is a difference between the action learner and the action researcher. "The action researcher is committed to learning from investigation, making decisions about necessary change, applying these and then evaluating the consequences....In action learning research may not be the primary aim and the project may not involve any formal research at all. The researcher in action research may be a lone individual, although there will inevitably be others involved in the project". Even though McGill explicitly defines the difference between action learning and action research, the tenant of reflection is central to both. In describing action research Avison et al. (1999) state that action research encourages researchers to experiment through intervention and to reflect on the effects of their intervention and the implications of their theories. Considering action learning and action research within the confines of Kolb's model, it is evident to the author that both action learning, as outlined in the Revens centre model in figure 1, and action research defined by Avison complements both sides of Kolb's learning model. Action learning ultimately results in the formulation of new theories and concepts, while action research provides the framework to test these concepts in real situations, gaining feedback from the experience, modifying the theory as a result of this feedback and trying the altered version again.

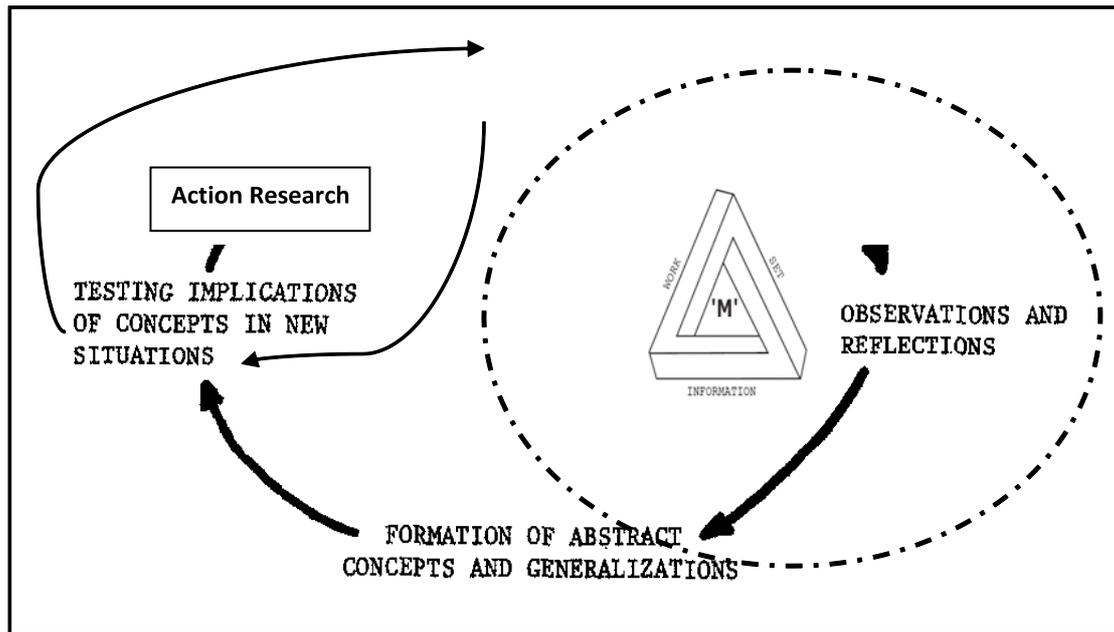


Figure 3 – Integrating Action Learning and Action Research within Kolb's model.

Figure 3 above illustrates the result of placing the Revens model within Kolb's 'experiential learning cycle', highlighting the reflective process on the right side and the action research process on the left. However, alternatively the Revens triangle cannot be firmly isolated within Kolb's cycle as it may be argued that monitoring and reflection does not discontinue during 'testing implications of concepts in new situations', as the reflective process should be employed throughout the research process and 'action sets' continued possibly to the end of the research and well beyond. It is not the author's intention to set out his methodology as action research but rather outline its difference to action learning and commit himself to the process of reflection and action learning within the doctoral group setting during the course of the author's research.

3 SELF DEVELOPMENT THROUGH INDEPENDENT LEARNING AND REFLECTION

3.1 Reflection in Teaching – an introduction to reflection in teaching practice

The author is not new to the concept of reflective practice. The first introduction the author had to a structured reflective process came while in his current role as a lecturer in the School of Real Estate and Construction Economics in Dublin Institute of Technology (DIT). The author felt that reflection in his teaching practices did not come to fruition until he had read some of the philosophies from academics in the learning and teaching field and attended classes in DIT's learning and teaching centre. Some of the theories and international best practices outlined in the recommended reading for the classes were useful in reflecting on potential issues within the classroom and subsequently on the authors own research interests. One of the improvements the author implemented as a result of this reflective process is outlined hereafter.

3.2 The Issue

The BSc. programme in Construction Economics and Management in the School of Real Estate and Construction Economics in DIT is designed for those who wish to work as Quantity Surveyors (QS) and economic advisors/managers in the construction industry. The most important subject in the course and the cornerstone of the QS profession is the ability of the students to carry out a technical function called 'measurement' or 'take off'. Throughout their career, QS's call on this technical ability continuously. It also underlines many of the professional and managerial practices in the profession. Measurements importance in the profession cannot be overstated and thus it is included as a module

or part of a number of modules in all four years of the BSc. programme. In 2008/09 and 2009/10 the author delivered 'Quantity Surveying 2A' in second year of the course, which seeks to extend the students ability to prepare take-off solutions for more complex building elements.

Students appreciate the importance of the module and interest and attendance on the module lecturers was high. However teaching the subject in the academic year 2008/09, the author documented that attendance on the tutorials was significantly lower than the lecturers. Tutorials are very important in the module as it provides the students with a platform to ask questions and address any problems they may have understanding the lectures.

3.3 Assessment

The assessment method in the module was continuous and was carried out in three parts. The first was a mid semester measurement submission allocated with 40% of the overall mark. The second part of the continuous assessment was an open book exam on the 'Buildsoft' measurement software and was allocated 40% of the overall grade. The third part was an open book two hour measurement exam in the last week of the semester, worth 20%.

The purposes of assessment in this module are to measure the student's knowledge on the subject matter and enhance their learning. Light et al. (2000) claims that these purposes are often referred to as summative and formative assessment. The assessment methods outlined in the module descriptor whether intentionally or not, solely measured the student's knowledge of the subject matter rather than helped them learn and understand the knowledge while doing so. The author reflecting on this process hoped to increase attendance in tutorials and he determined the best way to achieve this was to incorporate a formative assessment strategy into the tutorials. The author felt, of the three projects, the mid-semester submission lent itself to formative assessment more than the other two. The mid semester submission was traditionally carried out in the review week (week where formal classes were not scheduled), mid way through the semester. The students were encouraged to carry out this task together in class over three days but their submission was to be individual. This encouraged peer learning in a member set, but there was no feedback from the lecturer while the students were carrying out their task. After observing the dynamic within the classroom while the students carried out their project, the author noted the students were working in groups and learning from each other but many of them carried out the exercise without understanding the calculations involved and their relevance to the drawings.

The author devised a strategy the following year (2009/10) to incorporate the mid semester project into the tutorials. Instead of handing out the mid semester project in review week, the project was given to the students in the second week of the semester. Noting the advantages of collaboration within groups, the author divided the class into six member sets of eight students and forty minutes per week was allocated to each group during the four hours of tutorials per week. The author completed the task himself and asked the students to do ten calculations each week before they came to the tutorials. The majority of the students who attended the tutorials completed their calculations each week and the author examined their results and gave them feedback on each calculation. The results themselves formed the basis of feedback during learning as advocated by Biggs (1999). This way the students could see if they were getting the right results and following the proper methodology and the author could determine if they understood the subject matter.

3.4 Analysis

The students were evidently pleased with this process, not only were they getting continuous feedback on their calculations, they could also determine if their results were correct. Light et al. (2000) points out the major advantage of small group teaching is to ensure what the teacher is covering in lectures is understood by the students. The author was pleased with the process as he could determine the module content he was addressing in class was been implemented in practice. For the purposes of comparison the author compared the year's documented attendance to the previous year and noted that attendance in tutorials increased by almost fifty percent. The trend of results also indicated that those that attended tutorials achieved better marks than those who did not.

3.5 Conclusions to Reflection in Teaching

The author concluded this assessment method encourages greater understanding of the subject matter as it provides the students with more time to digest the task and plot their course of action. Donnelly & Fitzmaurice (2005) point out that the continuous feedback students receive in formative

assessment allows them to address any gaps in their knowledge or skills. The author contends the process of assessment which he employed is best described by Brown & Knight (2002), where they advocate a process of assessment which is done with and for the students rather than too the students.

Although the issue outlined above does not necessarily inform the subject matter of the author's doctorate, it was an invaluable learning process which provided an experience which helped the author subsequently frame his reflection and action on an issue he has with one of his research interests (this will be discussed below). During this time, the author gained valuable advice and observations from colleagues both within his school in DIT and in the teaching and learning classes he was attending. Although this process was not carried out in a formal action learning set (as outlined in the Revens learning triangle) – it demonstrated to the author the value of collaborating with colleagues and other practitioners carrying out reflective practice.

4 PROCESS BY WHICH AUTHOR'S RESEARCH FOCUS HAS EMERGED FROM THE PROCESS OF REFLECTION IN HIS PRACTICE

4.1 Author's Experiences with Life Cycle Costing

The author's research interest and possibly the backbone to his doctorate research is a concept in the QS profession described as Life Cycle Costing (LCC) or Whole Life Cycle Costing (WLCC). The author first came upon this concept during the third year of his undergraduate studies on Construction Economics in DIT in 1995/1996. The concept was described by his lecturer at the time, as a service provided by QS's to evaluate future costs of the constructed asset, 'in use', over a given time period. The author was quiet interested in this concept and was looking forward at some point in his future career to see how these calculations were carried out and how this service was provided to QS clients.

The author graduated in 1997 and spent 12 years working as a Professional Quantity Surveyor (PQS) and construction manager in the United States and Ireland prior to taking up a post in DIT as a lecturer in the School of Real Estate and Construction Economics in 2007. While the author was practicing quantity surveying he gained a diverse range of experience in a wide range of construction sectors, including professional experience notably in the areas of construction management, value management, project controls, and change management. The author did not encounter the concept or worked on a project during his professional career where he was required to carry out LCC Analysis (LCCA). The author believed, having been exposed to many areas in the QS profession and having worked on international complex construction projects, that this concept was one of those best practice approaches that existed in academia and theory but was not carried out in practice.

The authors own experience was subsequently supported by the thesis of Niamh Hourigan (2011) where she identified a relatively small proportion of chartered PQS's who have carried out or are carrying out LCC or WLCC for their construction clients.

4.2 Whole Life Cycle Costing and Life Cycle Costing

Before explaining the nature of the author's research interest or issue within his research interest, it is necessary to clearly define the meaning and scope of LCC and WLCC. This is carried out so that the author's reflections can be considered with some understanding of the subject matter. Confusion can exist over the terminology as different publications use different terms to describe the concept of LCC. The National Institute of Standards and Technology (NIST) in the United States defines the WLCC of a facility as "an economic evaluation in which all costs arising from owning operating and maintaining a building over a certain study period or building life cycle are considered to be potentially important in option appraisal, design decisions and cash flow forecasting" (Fuller et al. 1995, p.1-1). The Office of Government and Commerce (OGC) (2003, p.5) in the United Kingdom defines WLCC "as the costs of acquiring it, the costs of operating it and the costs of maintaining it over its whole life through to its disposal – that is, the total ownership costs". The International Standards Organisation, BS ISO 15686 – Part 5 (2008, p.2) describes whole WLCC as a "methodology for the systematic economic consideration of all whole life costs and benefits over a period of analysis, as defined in the agreed scope". In this paper 'life cycle cost', 'whole life cycle cost', 'whole life costs', 'life cycle cost analysis' and 'life cycle cost model' are terms used interchangeably defining the same concept, although not necessarily defining the same action within the concept, which will be explained in greater detail in the

author's thesis. This paper however, predominantly uses the terms LCC and WLCC as outlined in the definitions above.

4.3 Informing the Author's Research Interest

In September 2009 the author was asked by his Head of School, Tom Dunne, to deliver the module 'Project Cost and Financial Control' on the MSc. in 'Advanced Construction Cost Management' in DIT. When the author examined the module descriptor in order to prepare his lectures, he found that LCC was part of the module content. The author wanted LCC to be of real benefit to his students (provide them with the tools to carry out meaningful LCC calculations), rather than just teaching them the theory, which is all he received in 1995/6. The author contacted one of the eminent researchers in LCC, Dr. Robert Charette from the Building Engineering Faculty of Concordia University in Montreal, Canada. Dr Charette kindly provided the author with lecturing material such as presentations, LCC financial tables, workshops, workshop solutions and LCC case studies. The students reacted positively to the authors lectures and gave encouraging feedback in their end of semester survey of the module.

In May 2010 the Society of Chartered Surveyors Ireland (SCSI) and DIT invited Dr. Charette to carry out a seminar and workshop for SCSI members and DIT staff on LCC. Mr Charette guided the participants through the calculation methodology and practical application of LCC exercises. The attendees gained the knowledge through the workshops and presentations required in carry out isolated option appraisal of building components over a selected study period.

Dr Charette described the data and formulae required and when they may be used in LCC calculations. He outlined how a scientific calculator or financial tables can be used to carry out LCC calculations in order to determine the applicable LCC factors. Engaging in reflection during the workshop and soon thereafter the author considered this method quite time consuming, as each variable must be inputted to determine the relevant result and each result must be accumulated to determine the total WLCC. Fu et al. (2007) and Hunter et al. (2005) agree with the author's observation when they state that carrying out individual LCC calculations of every component of a building is very time consuming, even with the aid of financial tables. In hindsight the author's actions at this time followed the concept but forward by the Revens Centre in their 1996 learning model (Botham & Vick, 1998). The authors own experience was put in the context of previous studies on the subject matter and this issue was also discussed at the time with a number of the author's college colleagues and quantity surveying practitioners, thus touching on all three corners of the Revens triangle.

4.4 Life Cycle Costing and Ireland

The requirement for LCC in Ireland was heightened by the introduction of the Construction Works Management Framework (CWMF) in May 2010 by the Irish government, which contains an "integrated set of contractual provisions, guidance material, technical templates and procedures, which cover all aspects of the delivery process of a public works project from inception to final project delivery and review" (Dept. of Finance, G N 2.2. 2009, p.3). One of the provisions as outlined in the guidance notes, to be provided by QS's on all future projects is the requirement for WLCC on public works contracts as a standard service.

The author determined if this process is to be carried out for each component within the assets life cycle for the purposes of a WLCC Analysis (WLCCA) – the process would burn up the consultant's fee within months or possibly weeks. If LCC is to be accessible to construction consultants and ultimately their clients, the process must be carried out in a manner which automates the mechanical and time consuming calculations and is provided in a format which can be easily understood by construction clients.

5 FOCUS ON LIFE CYCLE COSTING AS AUTHOR'S DOCTORAL RESEARCH

5.1 Initial Secondary Research

A Building Research Establishment (BRE) study of WLCC conducted by Cliff & Bourke (1999) found that although the significance of LCC has been recognised on construction projects, as early as the 1980's and substantial amounts of research into the LCC has taken place, the application has not been implemented into standard practice. Fu et al. (2007, p.86) cited a number of papers in the field,

including Fischer and Kunz (2004), Chanter & Swallow (1996), Cliff & Bourke (1999) and Flanagan & Norman (1984) that determined that the reason for this includes the lack of historical data and databases on operation and maintenance costs; the significant absence of standardisation across the construction industry, in terms of scope; and the complexity of calculating the factors involved in LCC.

5.2 Building Information Modelling

Another factor to take into account is the emergence of Building Information Modelling (BIM). BIM is beginning to change the way we build, the way the buildings look, the way they function and the way buildings are maintained and managed (Godager, 2011). Advances in computer aided design and measurement such as BIM cannot be ignored in researching future developments within the QS profession. Sabol (2008) maintains that BIM offers the capability to generate take-offs, counts and measurements directly from a model, which provides a process where information stays consistent throughout the project and changes can be readily accommodated. Quantity take off and estimating using BIM software, in conjunction with cost data, is a comprehensive process that maps components of three-dimensional building models to material, labour and equipment cost data (Sylvester & Dietrich, 2010)

The BIM model though sophisticated is not extensively used to provide quantity surveyors and estimators with the data requirements and tools to carry out LCC. Incorporating LCC calculations within the BIM model or in an external application with a BIM interface could leverage the capabilities of the technology providing QS's with the financial tools required to select the most economical advantageous solution.

5.3 Focus of Literature Review

It is the author's intention to investigate the concept of LCC and WLLC to examine the national (Ireland) and international methodologies on LCC. The author will also consult a wide range of literature consisting of but not limited to journal papers, professional publications and conference papers. The secondary research will be carried out with the intention of further focusing the author's research interest within the methodologies on LCC and the outlined deficiencies in the process both form problems identified through the author's reflective practice and issues highlighted in secondary research. The author will endeavour to utilise the latest developments in construction technology and informatics such as BIM.

6 CONCLUSIONS

Reflection is an important human trait. It distinguishes us from what Dewey describes as the reactive animal tendencies of the 'brute'. If reflection is a natural human trait, why consider it in the context of learning. The author would have been quite sceptical formalising such a natural process until he engaged in reflection and undertook the process as part of his teacher training in the learning and teaching centre at DIT. He found it helpful to allocate designated time to reflect on his work and document his reflections, outlining a new course of action and implementing it in practice. At the time, the author was unaware that this structured process has been recognised by such eminent researchers such as Dewey, Schon, Moon and Kolb, to name but a few.

The author has gained a valuable insight into the benefits of reflective practice over the course of attending the doctorate workshops and the process of reading for and of writing this paper. Particularly the concepts and theories on reflection outlined in section 2 helped shape a framework that focused the author's ideas and issues, whereby the author's thesis topic emerged. The author is excited to follow the path laid down by engaging in the reflective process and the author's doctoral journey, thankfully, looks much clearer.

REFERENCES

- [1] Avison, D., Lau, F., Myers, M. & M. Nielsen (2009). Action Research: make academic research beginners, Understanding BIM. Sybex.
- [2] Biggs, J. (1999). Teaching for quality learning at university. Buckingham: Open University Press.

- [3] Botham, D. & Vick, D. (1998). Action Learning and the Program at the Revans Centre. *Performance Improvement Quarterly*, 11(2), pp. 5-16.
- [4] Brown, S. & Knight, P. (2002). *Assessing Learners in Higher Education*. London; Kogan Page.
- [5] Charette, R (2010). Life cycle costing seminar/workshop for green buildings, Workshop notes distributed in the workshop session – Life cycle costing seminar/workshop for green buildings, at Dublin Institute of Technology, Dublin: on May 15, 2010.
- [6] Clift, M. & Bourke, K. (1999). Study on whole life costing. London: BRE report, CRC.
- [7] Department of Finance (2009). Capital works management framework; Guidance notes, Planning and control of capital costs, GN 2.2: Dublin: Department of Finance.
- [8] Dewey, J. (1933). *How We Think*. New York: D. C. Heath.
- [9] Donnelly, R. & M. Fitzmaurice (2005). Designing Modules for Learning. In S. Moore, G. O'Neill, and B. McMullin (Eds.), *Emerging Issues in the Practice of University Learning and Teaching*. Dublin: AISHE.
- [10] Fu, C., Kaya, S., Kagioglou, M. & Aouad, G. (2007). The development of an IFC-based lifecycle costing prototype tool for building construction maintenance. *Construction Innovation*, 7(1), pp. 85-58.
- [11] Fuller, S. & Petterson, S. (1995). Life cycle costing manual for the federal energy management program NIST handbook 135, United States Department of Commerce: National Institute of Standards and Technology.
- [12] Godager, B. (2011). Analysis of the Information Needs for Existing Buildings for Integration government. *Structural Survey*, 23(5), pp. 346-58.
- [13] Hatton, N. & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education*, 11 (1), pp. 33-49.
- [14] Hinett, K. (2002). Improving learning through reflection – part one. Higher Education Academy. Retrieved April 6, 2012, from http://www.new1.heacademy.ac.uk/assets/documents/resources/database/id485_improving_learning_part_one.pdf
- [15] Hourigan, N. (2011). Improving the service provision of life cycle costing in Ireland's PQS offices, Dublin Institute of Technology, Dublin.
- [16] Hunter, H., Hari, S. & Kelly, J. (2005). A whole life cycle costing input tool for surveyors in UK local government. *Structural Survey*, 23(5), pp. 346-58.
- [17] International Standard Organisation (2008). BS EN 15868-5:2008 Building and constructed asset – Service life planning; Part 5 – Life cycle costing. United Kingdom: British Standard Institute (BSI).
- [18] Kolb, D. (1976). Management and the Learning Process. *California Management Review*, XVIII (3), pp. 21-31.
- [19] Light, et al. (2000). *Learning and teaching in higher education: the reflective professional*. London: Paul Chapman.
- [20] Mann, P. (1998, 17 April). Trust to Your Tacit Knowledge, *Times Higher Education Supplement*, Research, VII.
- [21] McGill, I. (1995). *Action Learning: A Guide for Professional Management and Educational Development*. London: Kogan Page.
- [22] Moon, J. (1999). *Reflection in Learning and Professional Development, Theory and Practice*. London: Kogan Page.
- [23] Office of Government Commerce (2003). *Whole life cycle cost management, procurement guide no 7; achieving excellence in construction*. London: Office of Government and Commerce (OGC).
- [24] Proceedings of the 28th ISARC, Seoul, Korea, pp. 564-569

- [25] Raelin, J.A. (1997). A Model of Work-Based Learning. *Organisational Science*, 8(6), pp. 563-578.
- [26] Roberts, S., Dr. (2008). Engaging in reflective practice during periods of workplace experience: a Built Environment perspective. Paper presented in the Higher Education Academy Conference, Birmingham, England.
- [27] Sabol, L. (2008). Challenges in Cost Estimating with Building Information Modelling, Design + Construction Strategies - The Power of Process in the Built Environment, retrieved April 2, 2012, from www.dcstrategies.net/files/2_sabol_cost_estimating.pdf.
- [28] Sattineni, A. & Bradford, R.H. (2011). Estimating with BIM: A Survey of Us Construction Companies,
- [29] Schön, D. (1983). *The Reflective Practitioner. How professionals think in action*. London: Temple Smith.
- [30] Sylvester, K. & Dietrich, C. (2010). Evaluation of Building Information Modelling (BIM) Estimating Methods in Construction Education. Proceedings of the 46th ASC Annual International Conference, Wentworth Institute of Technology, Boston Massachusetts, Retrieved April 10, 2012, from <http://ascpro.ascweb.org/chair/paper/CEUE221002010.pdf>.
- [31] Van-Manen, M. J. (1977). Linking Ways of Knowing with Ways of Being Practical. *Curriculum Inquiry*, 6 (3), pp. 205-228.