

:: Refereed Article A1:**Does embedding an ICT certification help align tertiary programs with industry?: A study of CCNA workplace perceptions**

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Abstract

In the last decade there has been an international drive to determine the needs of the ICT industry and skills required by graduates. The intention is to ensure tertiary education is aligned with industry and to suitably prepare students for employment. Among the various initiatives, embedding of industry certification training is one method commonly used to help achieve this.

This paper first looks at the literature on industry alignment and the embedding of ICT certifications. It then gives an overview of the changes in the networking courses taught at Wintec over the last ten years. A study of workplace perceptions of the Cisco Certified Network Associate (CCNA) courses at this institute is also described, with conclusions drawn about the effectiveness of embedding this certification. In particular the paper investigates how well the courses meet the needs of the ICT industry in the Hamilton/Waikato region. CCNA course topics that are found to be most useful in the workplace are highlighted, as well as the perceived value of the courses for new employees, employers and for people in their career.

Keywords

Industry Alignment, Embedding Industry Certifications, Networking, CCNA, Cisco

1. Introduction

Tertiary institutes constantly evaluate their curricula to ensure they are kept up to date with the rapid changes in the Information and Communications Technology (ICT) industry. In the last decade there have been various initiatives to determine the industry's needs and requirements of graduates, as well as determining ways to help align tertiary education with these needs. Embedding industry certification is one method to assist in this alignment.

Robertson and Corbett (2004) described how the four CCNA modules (CCNA1 – CCNA4) were initially embedded at Wintec. This paper describes the updates and further embedment of the CCNA curricula, as well as how networking courses in general have evolved over the last ten years at the institute.

This paper also extends and evaluates a previous study by Rajendran and Corbett (2010) in the context of industry alignment and certification embedment. Industry employed people with networking/ telecommunications roles, who have studied the CCNA courses at Wintec were interviewed. The authors surmised that these students who work in industry have a body of experience that could help in understanding how well the course is aligned with the ICT industry needs. CCNA course topics that are directly used by these professionals in their employment are identified and CCNA course topics that are transferable to other aspects of their work are also investigated. Finally we see how these results relate to the industry needs outlined in the literature. It is important to note that all the people interviewed were employed in Hamilton, so results are geographically localised. Also suggested in this paper are ways to extend this research to include people from different parts of New Zealand and internationally.

2. Industry Alignment

There have been initiatives in Australia to determine the ICT industry requirements of graduates (Kopi et al., 2009; Hagan, 2004). Koppa et al. (2009) surveyed graduates from some well known Australian universities with a particular focus on the relevance of the curricula content to industry. A broad mismatch was found in soft skills such as teamwork, problem solving, communications, the organisation of information, project management, client relationships etc. The majority of graduates also felt they were well prepared with technical skills but not soft skills. There is an indication that this is partly because the students themselves did not realise the importance of these skills while studying and did not take it as seriously as it deserves. Also "graduates claimed they were generally well prepared in technical skills but would prefer more exposure to new and emerging technologies" (Kopi et al., 2009).

Similar studies in the USA (Summer & Yager, 2008; Benamati & Mahaney, 2007) and Taiwan (Yen et al., 2003) also identified the need for soft skill development of graduates.

For the New Zealand ICT industry, Asgarkhani and Young (2010) collected data from a focus group of industry representatives who looked at industry needs in Canterbury and New Zealand. They gave views on the occupations and roles that are foreseen to be in high demand over the next five years. They also listed the ICT skills required for graduates to be successful in this sector. There was consistency between the perceived roles of Canterbury and NZ as a whole. Over the 5 year period, Network Administrator and ICT Support Specialist roles are among the most highly rated roles and skills. Conversely it is interesting to note that the Telecommunications Engineer and Telecommunication Network Engineer were not so highly rated.

Internships are another method identified to help in aligning with industry (Dechering, 2010; Mann & Smith, 2010). Internships would also help in developing soft skills. Dechering (2010) also mentions site visits and industry-directed assignments as a means of aligning courses with industry.

3. Embedding Industry Certification in Tertiary Education

Cisco and Microsoft are considered to be industry leaders in vendor-specific ICT certification (McGill & Dixon, 2004). Unlike some professions (e.g. accounting and legal), ICT does not have a profession-wide certification. However there are professional bodies (NZ Computer Society, 2009; IEEE Computer Society, 2009) and vendor-specific certification is very highly regarded by key stakeholders (Jovanovic, Bentley, Stein, & Nikakis, 2006) including; employers, educational institutes and students (Robertson & Corbett, 2004; McGill & Dixon, 2004; Gutierrez & Tawa, 2003).

While the author was unable to find any research that specifically addresses the questions raised in this paper, research was found that discusses student feedback on the CCNA course itself (Gutierrez & Tawa, 2003), as well as a wider context where views on multiple ICT certifications including CCNA were sought (White & Carew 2006; McGill & Dixon, 2004).

The work by McGill and Dixon (2004) investigates student perceptions of having ICT

certification. Some students who participated in this study were working in industry. Their focus differs to this paper in that it surveyed a different range of students and included several additional certifications.

Others highlight issues of integrating ICT certifications in tertiary education (Jovanovic, Bentley, Stein, & Nikakis, 2006; Robertson & Corbett, 2004; Gutierrez & Tawa, 2003; Koxinieć & Dixon, 2002; White & Carew, 2006), as well as a host of possible risks of ICT certifications. Examples are; the on-going debate about whether they are appropriate for an academic environment like universities (Koxinieć & Dixon, 2002; Jovanovic, Bentley, Stein, & Nikakis, 2006; Hitchcock, 2007), and the concern that unbiased neutral groups should be involved in course design and assessment (McGill & Dixon, 2004). Despite all this, there clearly appears to be a positive movement towards including ICT certifications in tertiary education (Koxinieć & Dixon, 2002; Hitchcock, 2007; McGill & Dixon, 2004; Robertson & Corbett, 2004; White & Carew, 2006; Gutierrez & Tawa, 2003).

Effects of certification on salaries and possible advantages to potential employees are included in this paper but are not the main focus. Interviewees were asked about career progression and their perception of benefits to potential employees.

Rajendran (2007) analysed a variety of telecommunication job advertisements and discovered that a significant number of employers indicate that it was either required or beneficial for applicants to have Cisco knowledge and skills. Though not specifically mentioned in this paper, Cisco certifications were requested in many of the Cisco related job advertisements. McGill and Dixon (2004) recognise that "Certification is perceived as an important factor in achieving employment" and also notes that "increasing numbers of job advertisements specify a preference for those holding certifications." This is supported by the Global Knowledge (2009) report that states: "67% of hiring managers believe that certifications impact the salaries of potential employees". (Global Knowledge, 2009)

4. Networking Courses at Wintec

Over the last ten years, ICT certification has been increasingly embedded into networking courses at the School of Information Technology at Wintec.

The Cisco Networking Academy was first launched in the USA in 1997 and by October 2000 CCNA training was available in more than 75 countries and in 9 languages (Cisco Networking Academy, 2010). In 2000 a business case for embedding CCNA was developed at Wintec that highlighted the costs, possible risks and estimated the return on investment for the School of IT at Wintec (Robertson & Corbett, 2004). With the approval of management, the school embedded the CCNA courses into their Diplomas in ICT levels 5 and 6 in 2001. These courses were also made available to business organisations, such as Telecom and Alcatel Lucent, by way of evening classes. People working in IT and the telecommunications industry, including the Wintec Information Technology Services (ITS) staff, have continued to enrol in these evening classes, and in 2006 CCNA was introduced into the school's Bachelor of Information Technology (BIT) degree.

During 2005 the school changed its networking operating system (NOS) from Novell Netware to Microsoft Windows Server 2003 and included the new NOS in its networking papers. This change of NOS aligned the school with Wintec's new campus network technology and a global trend away from Novell Netware towards the increasingly dominant Microsoft technologies (Rajendran, 2007). At the same time elements of the Microsoft Certified Systems Administrator (MCSA) certification were included in the networking papers. At present steps have been taken to integrate one of the MCSA courses into the Diploma.

5. Workplace Perceptions of CCNA Embedment

The goal of this research was to ascertain how well aligned the CCNA course is with industry needs in the Hamilton/Waikato region. The curriculum course content and assessments are set by Cisco and accessed online. This limits the ability to vary the theory and practical skills that can be taught. Despite these limitations, it would be

useful for instructors to know which CCNA topics are perceived to be widely used in industry, as they may wish to further expand on these topics while teaching their CCNA classes and encourage students to do their own personal research in these areas. This could be taught in conjunction with the rest of the material required for students to succeed in the course. The intention behind 'going the extra mile' in this way is to provide more awareness to full-time students of what is happening in industry and thus further help in their preparation for employment. Cisco may also find this study useful when designing the next version of their courses and it may help when evaluating other general networking courses.

5.1. Interviews

Interviews were the method selected to obtain data. Approval to proceed was first obtained from the Wintec Ethics Committee and each participant was selected and gave informed consent subject to confidentiality and anonymity. Participants were selected from students who had completed Cisco Certified Network Associate level three or four courses (CCNA3 or CCNA4) and who were currently working in the ICT industry with networking/telecommunications related roles, were identified from the school's database. Two pilot interviews were conducted to ensure questions were relevant and useful.

Structured Interviews were conducted between October 2009 and February 2010. Interviews lasted between 30-60 minutes. CCNA3 was chosen as a minimum criterion for those selected for the interview because by this stage they would have studied three quarters of the CCNA material and be in a position to compare it to their work.

Interviews were found to be an excellent tool for this study. It gave the author an opportunity to clarify answers and give a thorough understanding of each participant's role and tasks within their organisations. It also gave insight into their feelings and perceptions. Although the format and main questions were the same across all interviews, it was found that each interview was quite unique and needed to be slightly tailored to each participant.

Some participants changed roles between the time they studied CCNA and that of the interview. If both roles were in the telecommunications field then each job was treated independently and two sets of data (data samples) were obtained in these cases. This was needed as each role may use different technology, skills and knowledge. If the participant was working in a network/telecommunications role but moved to another type of role, then data was only collected for their network/telecommunications role.

When each interview was completed, the participants were emailed the written notes of the interview and given an opportunity to modify them to ensure accuracy.

5.2. Results

Employers ranged from large multi-national corporations to small businesses. Participants largely (73%) came from 3 companies (Figure 1). Company A was a large multi-national telecommunications organisation and companies B and C were the Information Technology Services (ITS) departments of two large Hamilton companies.

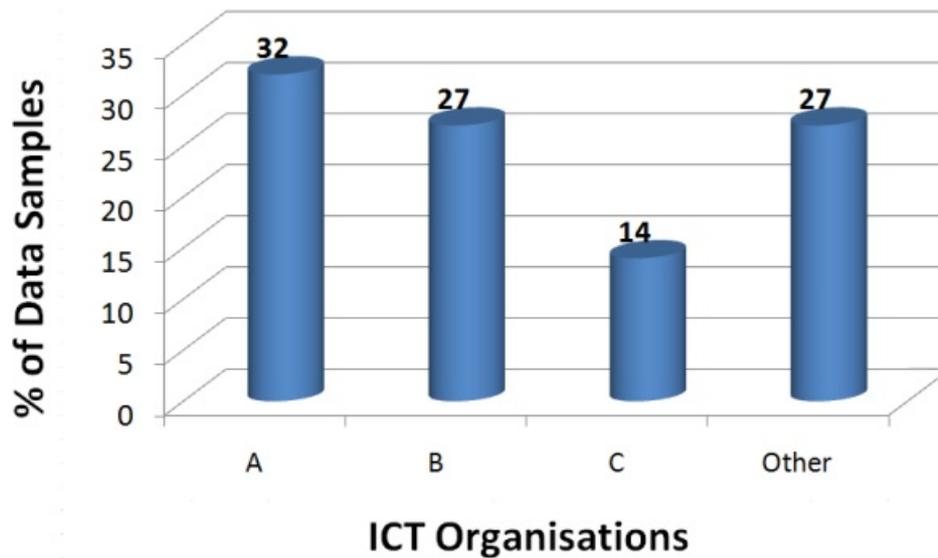


Figure 1. Participant Employer Distribution

There were 18 participants (16 males and 2 females) and 22 data samples in total. Participants held a variety of roles specific to networking/telecommunications as shown in Figure 2. Seventeen (94%) participants had completed all four modules. There were 4 (22%) participants that worked in more than one role during the time of CCNA study and when they were interviewed. One participant was self-taught and all others studied CCNA at Wintec. There were no participants who moved out of a network/telecommunications field at any time. One person gained employment after completing the course, another part way through the course and one was working part-time. Everyone else was working full-time while simultaneously studying the course.

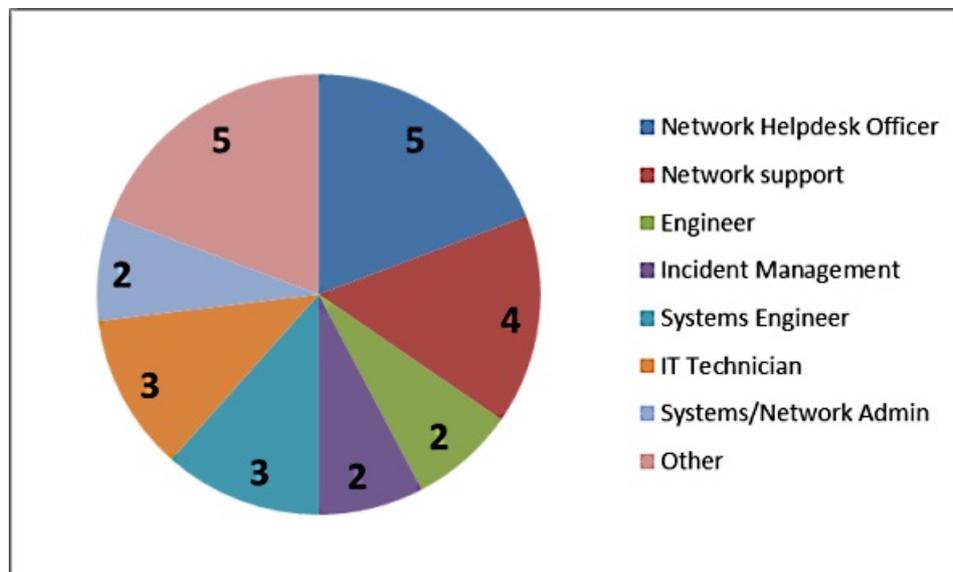


Figure 2. Number of data samples for each role

From those that had completed all four modules, five (28%) had passed the external exam and 6 (33%) were planning to take it within a year. The remaining thirty eight percent had no immediate plans to attempt the exam.

Participants were asked to rank the importance of CCNA knowledge and skills in their current role on a scale of 1-5 (Not Important – Vital). The average was: 3.4. Participants were asked to rank the importance of CCNA knowledge and skills for a new employee joining their team (i.e. doing the same job) on the same scale. The average was: 3.6.

Eleven (50%) samples ranked CCNA knowledge and skills to be more important for a new employee than it was for themselves. Eight (36.4%) considered it to be of equal

importance for new employees and themselves.

Fourteen (78%) of participants indicated that their management highly recommended staff to study the CCNA course, and only one felt that it was a requirement for some roles in their organisation.

Although not specifically asked, ten (56%) participants felt that the CCNA course was of benefit to personal career progression. i.e. helpful if they were applying for another role or moving to a different company in the future.

The course appears to cover all details relevant to Cisco devices encountered in industry. However 4 (22%) mentioned other devices (e.g. Cisco Adaptive Security Appliances 5520/5510 and Cisco Call Manager for Voice over IP) that are not part of the CCNA course.

5.2.2. Participant responses relating to Cisco course topics

Table 1 indicates (in the number of data samples) which aspects of CCNA are directly used in their employment, and which were considered transferable.

Table 1. The number of data samples for each CCNA course topic

CCNA Course Topic	Directly Used Transferable	
Network Communication Principles	19 (86%)	19 (86%)
Cabling a Network	14 (64%)	19 (86%)
Design Network: Subnetting	5 (23%)	10 (45%)
Design Network: Physical Layout	5 (23%)	7 (32%)
Routing Protocols	4 (18%)	5 (23%)
Routing Table Analysis	3 (14%)	6 (27%)
Access Control Lists (ACLs)	4 (18%)	10 (45%)
Network Switch Principles: STP	8 (36%)	7 (32%)
Network Switch Principles: Port Security	9 (41%)	7 (32%)
Virtual Local Area Networks (VLANs)	8 (36%)	8 (36%)
Wireless Local Area Networks (WLANS)	7 (32%)	8 (36%)
Wide Area Networks (ISDN)	3 (14%)	4 (18%)
Wide Area Networks (Frame Relay)	2 (9%)	2 (9%)
Wide Area Networks (Point-to-Point Protocol)	3 (14%)	4(18%)

Eight (36%) indicated that learning how to configure/program Cisco routers and switches helped when configuring equipment from other vendors, another transferable skill.

Some other vendor equipment mentioned included: Alcatel-Lucent switches/routers (28%), Juniper routers (17%) and Allied Telesyn switches (11%). There was also mention of Riverstone routers, Hewlett Plackard and Nortel switches.

As well as topics specifically included in the interview, 45% of participants added troubleshooting techniques to the list of acquired course skills they used. Three (17%) also add the concept of redundancy, where one uses extra network links/components to ensure reliability.

5.3. Results Analysis

As the majority of those interviewed (94%) had completed all four CCNA modules, there is a sound basis for comparison of industry requirements and course content. Only a small number (28%) had actually taken the CCNA external exam, but when this is combined with those that were planning to do so in the next year (giving a total of 61%), it shows that there is a desire to obtain the qualification. Many of those who were not planning to take the exam felt they just needed the knowledge and skills from the courses and would only take the exam if they were applying for another job. There could be other possible reasons for not sitting the exam such as; the absence of a local examination centre etc, that could be investigated in future

research, as deterrents were not specifically explored in these interviews.

As indicated in Table 1, the course topics that were most considered to be directly used in industry were; Network Communication Principles (e.g. the process of sending and receiving packets, Transmission Control Protocol, Open System Interconnection model etc) and Cabling a Network. Network Switch Principles, VLANs, WLANs and Equipment Configuration also scored highly.

Participant responses in Table 1 also indicate that the most relevant transferable skills were Network Communication Principles and Cabling a Network. ACLs, Subnetting, WLANs and Network Switch Principles are also notable. As mentioned, troubleshooting techniques were added by participants (45%) as another transferable skill. It is suspected that if this was specifically included in all interviews, this figure may have been somewhat higher.

86.4% of participants perceived that it was of greater or equal importance for new employees to have CCNA knowledge and skills compared to themselves. This is in line with the literature, where Cisco Certification is perceived to be an important factor in achieving employment (McGill, Dixon, 2004).

Participants, when asked about the value of CCNA for career progression, responded that they believed it was useful in their personal career, as 56% felt it was of benefit if they were to apply for another role. Many (78%) indicated that the qualification itself was not a management requirement, but stated there was a strong recommendation by their managers for staff to study CCNA. In fact, the only person who started working part-way through the course related that one reason his new employer hired him was because he was studying towards a CCNA qualification.

Common sentiments expressed by participants are as follows. Fifty percent mentioned the hierarchical nature of their companies. For example, when Level 1 Helpdesk Officers discover network faults, they would attempt to resolve it or pass the fault on to a higher level engineer or third party vendor. It appears that the course was useful in such cases, as it gave a thorough understanding of IP networking which helped when resolving issues or when giving specific details to the higher level engineer/vendor, thus saving time and money.

Two participants (11%) worked on a mobile network, and both mentioned that they work in the same room as people from other divisions of their organisations (IP and Transport Layer Engineers). So it was useful to have knowledge of the different aspects of telecommunications provided by the course to allow for better communications with their colleagues.

Two people (11%) felt the course was too long (it takes 2 years at Wintec - one semester per course) for students who work in industry. Another stated that initially he thought it was a long course, but then realised that the length was actually needed to help ensure the course material was thoroughly understood. It should be noted that those who were critical about the length of the course studied the older version of CCNA (version 3). This version requires students to complete each of the four courses consecutively. With the new 'Exploration' version, CCNA2 and CCNA3 can be studied simultaneously by those who wish to complete it in a shorter timeframe and are willing to undertake the higher workload. The speed of delivery was also noted as an integration issue in the literature (Koziniec & Dixon, 2002).

All participants commented positively on the course content. There was one Transport Layer Engineer who felt the course was very good, but recommends that some basics on Pleisochronous Digital Hierarchy (PDH) and Synchronous Digital Hierarchy (SDH) would be useful for those working with the transport layer. This could be considered, but it should be noted that the transport layer is not a focus for the CCNA courses.

There are also specific comments of interest. One interviewee, who worked in a small business, mentioned a client who specifically asked for an engineer with Cisco certification. As there was no one at the time in the organisation who was CCNA certified, the company did not get the contract.

The Literature suggests that having ICT certifications relate to salary gains, a higher base pay or higher average pay premiums (Global Knowledge, 2009; McGill & Dixon, 2004; Lamont, 2006). There is no evidence of that relationship found in this study. Although 78% of participants indicated that it is highly recommended by management for employees to take the CCNA course/exam, there was only one that felt it was a requirement.

These results show that CCNA provides students with many technical skills needed for employment. Soft-skill development is identified as an important industry need (Koppi et al., 2009; Summer & Yager, 2008; Benamati & Mahaney, 2007; Yen et al., 2003), but was not included in these interviews. CCNA has group case studies in each module, which aids in developing planning, teamwork, problem solving and communications skills as well as specific technical skills.

6. Future Research

A comparative study is underway with another institute in the South Island of New Zealand to explore the similarities and differences of between regions and the suitability of CCNA in each case.

It is observed in the interview results of this paper that only a small number of the interviewees sat the external CCNA exam after completing the four CCNA modules. A larger sample across NZ would help to draw more accurate conclusions about this. A number of participants in this paper mentioned that they did not feel the need to sit the exam unless they intend to apply for a new role at a later stage in their career. Other possible deterrents to sitting the exam, such as the distance to the examination/testing centre could also be investigated. There is no longer a testing centre in Hamilton and people have to travel to Auckland to sit the exam. There could also be other possibilities such as the fear of failing in adults etc.

To determine the extent to which soft-skills are developed by CCNA case studies would be a useful investigation, given the lack of soft-skills in ICT graduates was an important finding in the literature.

Another area of research would be how this study relates to Microsoft certification embedment given that the literature suggests that Microsoft is another key player in ICT industry certification.

7. Conclusions

People who studied CCNA at Wintec and who were also employed in the ICT industry were interviewed to determine how well the course is aligned with industry needs. From this it can be concluded that embedding the CCNA certification courses into programs at this institute has helped in aligning with the industry in Hamilton for those in telecommunications and networking roles. CCNA is considered to be of importance to these people in their career, and perceived to be of high value to new employees, for personal career progression and by employers. The CCNA course was highly recommended by employers rather than being a requirement.

There does appear to be a desire (61%) for people to gain CCNA certification by sitting an external exam, although few of the participants who completed all four CCNA modules (28%) actually sat the external exam. Further research could be done with a larger sample size to see the validity of this proposition and to investigate possible deterrents for not sitting the CCNA exam.

All participants were very positive about the course structure and content. The course topics that were considered to be most directly related to their jobs were; Network Communications Principles, Cabling a Network and Troubleshooting Techniques. Network Switch Principles, VLANs and WLANs also scored highly. Transferable skills were seen as inherent in the Network Communications Principles, Cabling a Network, ACLs, Subnetting and Equipment Configuration topics. Soft-skills were identified in the literature to be lacking in ICT graduates (Koppi et al., 2009; Summer & Yager, 2008; Benamati & Mahaney, w2007; Yen et al., 2003). CCNA has group studies in each course which develops both technical and soft skills. The extent to which the soft

skills are developed are not investigated in this paper and could be another area of future research.

The number of transferable skills and knowledge identified by participants indicate that despite the vendor-specific nature of the course, it is also sufficiently generic to be useful to those employed in a variety of ICT organisations and telecommunications/networking roles. Overall the embedding of CCNA has been a valuable investment for Wintec.

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