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Architects and engineers are two key types of design professionals who influence the use of wood products in construction. Eighty to ninety percent by volume of all residential structures in the U.S. are wood (Gupta, 2005). In 2010, the non-residential market was made up by 10% wood, 60% steel and 30% concrete (Non-Residential, 2010). Wood use in non-residential structures has been as low as 4% by floor area basis (Robichaud et al. 2009). While wood currently only makes up 10% or 1.5 billion board feet, estimates show that the non-residential wood market could be a potential 15 billion board feet. This was found by looking at where wood was used and could have been used instead of other construction materials. Cost, codes and lack of understanding of wood design are factors that have kept wood out of non-residential construction. It is possible, that with more education and a better understanding of wood, design professionals would utilize it more in non-residential structures. The possibility of wood use increasing in the non-residential sector makes understanding how architects and engineers perceive their knowledge is important.

When looking at construction as a whole, wood is used more than any other material in construction by weight or by volume, making it important that designers in the construction industry have a strong understanding and knowledge of this essential construction material (Gupta, 2005). Understanding what the educational needs are for professionals designing structures provides insight into what information should be provided them. In this study, we will be focusing on the educational needs for architects and engineers.

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Educational Needs Assessment of Designers in West Coast States:
Architects and Engineers on the Topic of Wood Products

by
Travis J. Roth

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Travis J. Roth, Author

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CHAPTER 1 -- INTRODUCTION

Architects and engineers are two key types of design professionals who influence the use of wood products in construction. Eighty to ninety percent of all residential structures by volume in the U.S. are wood (Gupta, 2005). In 2010, the non-residential structural system market was made up by 10% wood, 60% steel and 30% concrete (Non-Residential, 2010). Wood use in non-residential structures has been as low as 4% by floor area basis (Robichaud et al. 2009). While wood currently only makes up 10% or 1.5 billion board feet, estimates show that the non-residential wood market could be a potential 15 billion board feet. This was found by looking at where wood was used and possible areas it could have replaced other construction materials. Cost, codes and lack of understanding of wood design are factors that have kept wood out of non-residential construction. It is possible, that with more education and a better understanding of wood, design professionals would utilize it more in non-residential structures. The possibility of wood use increasing in the non-residential sector makes understanding how architects and engineers perceive their knowledge is important.

When looking at construction as a whole, wood is used more than any other material in construction by weight or by volume, making it important that designers in the construction industry have a strong understanding and knowledge of this essential construction material (Gupta, 2005). Understanding what the educational needs are for professionals designing structures provides insight into what information should be provided them. In this study, we will be focusing on the educational needs for architects and engineers.

Needs assessments are an important part of gathering knowledge about an industry and the professionals working in that industry. Needs assessments are used to focus on specific topics to help uncover perceived knowledge gaps and are a methodical process used to find gaps between current and desired knowledge. The difference is measured to identify the gap and the size of the gap. Depending on the needs assessment the measurement of the difference can mean different things. For example the difference between zero knowledge compared to the average response. Several educational needs assessments of the Oregon wood product industry have been conducted in the past, but these have focused on the employees of forest product companies. In contrast, this study examined architects' and engineers' knowledge about wood products to determine the educational gaps of this group of specifiers. The study also examined how design professionals identify continuing education courses and the course format they prefer.

Objectives

This study was conducted to gain insight into the educational needs of architects and engineers in Oregon, California and Washington concerning wood products and the utilization of wood in building design. The overall objective of the study was to explore the educational gaps that architects and engineers have in regards to utilization of wood in design. Studied were the perceived current level of knowledge that architects and engineers have about wood and wood products and the perceived importance of those areas to their professions were examined. The four main objectives addressed in this research were to:

1. Identify the current perceived knowledge levels of architects and engineers with respect to wood design.
2. Identify the specific educational gaps for architects and engineers with respect to wood design.
3. Identify the preferred avenue architects and engineers use to find their continuing education and method they receive their continuing education.
4. Identify the barriers to specifying wood products in construction.

CHAPTER 2 – BACKGROUND

Architects and engineers are both designers who directly affect how a structure is built. Architects design the layout and the aesthetics of structures, while specifying building materials. Engineers design how the structure needs to be built to withstand external and internal forces and have a lot to say about the structure. Together, these design professions are key players in specifying and utilizing wood and other materials in buildings. Due to the importance design professionals play the professionals are required to gain a license to practice in a state.

Licensing is a tool used to make sure that only qualified individuals can practice architecture and engineering, helping to produce the highest quality structures. This is important to the study because licensing is the architects or engineers way of showing they gained the needed skills through their education. The topics taught in education usually align with what future testing will cover. Looking at the licensing tests will help explain the reason certain topics and not others are taught in school. Presented in the following is an overview of the licensing process for Oregon.

Oregon, California and Washington each has its own set of rules and laws that govern how a design professional is certified. Each state has different requirements to remain certified but the states have similar processes to gain the license. The following background is for architects and engineers who are certified in the state of Oregon. This provides an example of the steps required, but is not comprehensive, for each state that is part of this study.

Licensing and Continuing Education

In the state of Oregon, architects and engineers are required to obtain a license to practice their professions. The state government sets the standards that must be met to obtain and maintain the license. The responsibility of meeting these standards falls to the individual looking to acquire or maintain their license. They must either provide the needed documents or take the required exams.

Architect requirements for licensing

The state government body that is in charge of overseeing licensing and regulating architects in Oregon is the Oregon Board of Architect Examiners. The board is made up of seven members, two from the general public and five from the architecture profession.

Oregon administrative rule #806, division 10 outlines the initial registration process that a new architect, who is not registered in any other board approved jurisdiction, must follow to become an Oregon registered architect. The applicant must meet three areas of qualification: 1) education; 2) experience; and 3) examination. The education requirement is a professional degree in architecture that is from a National Architectural Accrediting Board (NAAB) recognized program. The experience qualification is met by meeting the requirements of the Intern Development Program (IDP) published by the National Council of Architectural Registration Boards (NCARB). The examination requirement is split into three different parts, with the first being the Architectural Registration Examination (ARE), which was created and is updated by National Council of Architectural Registration Boards. The architectural registration examination is a written and practical evaluation of the applicant's abilities in the protection of public health, safety and welfare. The divisions of the architectural registration examination test include building design and construction systems; building systems; construction documents and services; programming, planning and practice; schematic design; site planning and design; and structural systems. All divisions of the architectural registration examination must be passed within a five year period, called the five year rolling clock.

Once applicants have passed this test and provided the documentation needed to prove their education and experience, they may use the title "Architectural Intern." The second part of the examination requirement is the board's jurisprudence examination (JE), which is an exam testing the candidate's knowledge of Oregon statues and rules governing the practice of architecture. The final part of the examination requirement is an oral interview with the board. This is a chance for the candidate to meet with the board and discuss Oregon laws and rules. Once all parts of the examination requirement are passed an applicant can use the title "Architect" in the State of Oregon.

Oregon licensed architects must follow the rules of professional conduct laid out by the Board of Architect Examiners in Oregon administrative rule #806, division 20. The seven areas of conduct are as follows: truthful statements to the board, responsibility to the public, competence, avoiding conflict of interest, misconduct, incompetency, and gross negligence. In all of these areas, the main concern is providing safety to the public.

Architect ongoing requirements for licensing

Architects who hold a license in Oregon must report hours of continuing professional education (CPE). This is part of the two year renewal or reinstatement process. Continuing professional education keeps architects informed about innovation and helps safeguard the health, safety and welfare of the public.

The requirements for maintaining a license are that each architect must complete a minimum of 24 continuing professional education hours for each two year renewal cycle. Architects can do excess hours and may carry a maximum of 12 continuing professional education hours into the next two year cycle. A continuing professional education hour must be a minimum of 50 minutes. This does not include breaks, meals and administration matters. These hours must relate to safeguarding the health, safety and welfare of the public. If hours are not achieved during the two-year cycle, the architect may receive a non-renewal of their license, other disciplinary action, or both.

It is the responsibility of the architect to record and report the continuing professional education hours earned to the state board. They must complete a board approved form to submit the continuing professional education hours. Members of the American Institute of Architects (AIA) may submit their hours by submitting a transcript from AIA. The Board does not review all submitted forms but randomly selects a number of forms each cycle to review. Licensed architects must keep the records for one 2-year year cycle, allowing the Board to review one full renewal cycle. Once reviewed by the Board, the architect has six months to make up any continuing professional education hours not meeting the standards of the Board. The falsifying of continuing professional education hours will result in the revocation of the license, other disciplinary action or both.

Architectural professional organizations

Architectural organizations have a strong role in connecting architects with continuing professional education hours. These organizations have resources that members may use to find continuing professional education hours in the members' location or on topics in which they have an interest or need. These organizations also lend creditability to continuing professional education hours, if they are hosted or put on by the organization.

The American Institute of Architects (AIA) is one such organization. AIA was established in 1857 and has approximately 83,000 members (AIA 2015, McKee 2009, Kane 2000). In 1992 AIA voted to pass a mandatory continuing education program for their members, recognizing that the experience gained from other professions such as doctors, lawyers and accountants creates a continuing education system that maintains high quality courses (Kane, 2000). Oregon has rules for the use of the AIA acronym. The person or entity that is using the acronym must be a member of AIA in good standing and have a current Oregon license. AIA sponsors continuing education experiences to help architects maintain their licenses and provides a course directory for their members to find approved course providers. AIA members may also use outside providers, which do not have ties to AIA, but must report these credits themselves. An outside provider is a company or organization that provides continuing professional development hours but is not preapproved by AIA. The outside provider system only accounts for 10 percent of the total credits earned by AIA members (Kane, 2000).

The National Council of Architectural Registration Boards (NCARB) is a nonprofit company comprising the legally constituted architectural registration boards of each state as its members. The National Council of Architectural Registration Boards is in charge of maintaining the Architect Registration Examination (ARE), the intern development program, and provides information for potential architects to find out what is needed to become one. The National Council of Architectural Registration Boards also provides recommendations on law and regulations to its members. Continuing education credits are provided by the National Council of Architectural Registration Boards in the form of a detailed written study. These are documents that can be read at the architect's leisure. Once the architect has completed reading, the architect may take online quizzes to earn the continuing education credit. These monographs fall under the approved course list by AIA.

The National Council of Building Designer Certification (NCBDC) is a third party accreditation organization of building industry professionals and also provides a national certification examination, which many states use as their standard or use as a basis for their requirements. Like the AIA, the National Council of Building Designer Certification allows qualified members to use the CPBD acronym to show that the building design professional is a Certified Professional Building Designer. Along with this service they also provide a list of approved continuing education providers.

Engineer requirements for licensing

People who are trying to become Professional Engineers must complete a full application and testing regime that the state of Oregon has created. The process is implemented by the Board of Examiners for Engineering and Land Surveying.

The first step for gaining an engineering license is to file the application for enrollment as an Engineering Intern. Applicants are required to provide proof of education, such as a degree from an engineering program approved by the state licensure board for the state where the applicant is applying. An official transcript demonstrating the completion of an engineering curriculum that meets the Board standard must also be submitted. For non-accredited degrees the applicant can apply to take the Fundamentals of Engineering examination based on an amended education and experience in the practice of engineering. The Board will determine if the education is equivalent to accredited degrees and the cost of doing the assessment will be carried by the applicant. Once the application is approved the applicant is eligible to take the Fundamentals of Engineering examination, which is made up of 180 multiple choice questions. The first 120 questions are the same for every engineering profession but the remaining 60 questions are discipline-specific. The applicant must choose the discipline that they want to pursue as an Engineer in Training in (e.g., chemical, civil, electrical…). Once an applicant passes the fundamentals of engineering examination they hold the title of Engineer in Training.

The next step is to apply to become a Professional Engineer in the applicant's chosen discipline, which can be different from what was chosen as an Engineer in Training. The application must include proof of four years of experience and education by references, official transcripts and current enrollment as an Engineer in Training. All experience must be supervised by a professional engineer to be considered. Once the application has been submitted, the applicant can take the examination for becoming a professional engineer. This examination, as well as the Fundamentals of Engineering examination, is written and scored by the National Council of Examiners for Engineering and Surveying (NCEES). Applicants must also pass a take home examination on the laws and rules of the state of Oregon (or the state in which the applicant is applying).

Professional engineers can also gain license in other states by filing an application for the license in that state. For example, in the case of a Professional Engineer pursuing a license in Oregon, the Oregon license can be given by committee, although that is not true for all states. The applicant must also provide evidence of education and experience with references. The last step after the Board has approved the education and experience is passing the take home exam on Oregon rules and laws.

Once the applicant has been accepted as a professional engineer, a biennial renewal of that certification starts. The professional engineer must meet the continuing professional development (CPD) requirements set by the state. The engineer must then provide proof of the completed continuing professional development by filling out the continuing professional development form. If this is not completed, then after five years a professional engineer must retake all examinations. During those five years the certification is considered delinquent and the professional engineer may not practice engineering.

Engineer ongoing requirements for licensing

For the state of Oregon, engineers must complete continuing professional development (CPD) hours every biennial renewal period to show a continuing level of competency. The engineer must gain 30 professional development hours (PDH) within the two year renewal period to be able to renew their license. The professional development hours will be recorded on the continuing professional development organizational form and submitted to the Board. If the Board audits the hours, then documentation must be provided verifying the professional development hours for the Board's review. The records of professional development hours must be kept for five years. Professional development hours must be related to the engineer's individual registration, with a clear purpose and objective that expands the skills and knowledge of the registrant. If an engineer obtains more than the required number of hours then they may carry a maximum of 15 professional development hours into the next renewal period.

Engineering professional organizations

The professional organizations that provide services for the engineering field function much like the architect organizations. The goal of the engineering professional organizations is to help maintain and create quality engineers that will look after the welfare of the population. The organizations do this by providing continuing education material and working with state governing boards to keep high standards for obtaining the title of professional engineer.

The American Society of Civil Engineers (ASCE) is the oldest national engineering society and was established in 1852 (ASCE, 2015). It currently has more than 140,000 members worldwide (ASCE, 2015). One of the main goals of ASCE is to promote lifelong learning of its members by providing tools such as continuing education courses. The ASCE provides a central location through its website for engineers to find events, published journals and other education resources.

The Structural Engineering Institute (SEI) looks to bring practicing engineers and academia together through networking to help drive cutting edge research. This is accomplished by publishing journals, holding conferences and providing continuing education. The SEI provides distance learning courses, webinars and seminars for continuing education credits. SEI is also part of ASCE.

The National Council of Structural Engineers Association (NCSEA) is a national organization that strives to constantly improve the quality of structural engineering as a profession. The NCSEA is also broken down into state-level organizations that help provide more specific information to the members based on what is going on in their state. The goal of the NCSEA is to provide a resource that makes communication between engineers easier and also provides a platform to communicate with engineering clients. The NCSEA also created the Structural Engineering Certification Board (SECB) which was established to be a third party certifier of engineers. This allows for currently licensed engineers to show that they are practicing structural engineers that are actively keeping up their education. Certified engineers must complete 15 professional development hours every year to maintain their certification.

Continuing education

Continuing education is an important part of keeping the professions of architecture and engineering up to date on advancements in the professions to provide safe and reliable structures to society. The need for continuing education is becoming more important due to the increasing speed at which knowledge is becoming obsolete (Muench, 2006). The need for continuing education to become easier for engineers to obtain is due to what Muench (2006) refers to as "knowledge half-life." Zelikoff (1969) conducted a study of an engineering student who, upon graduating, had a half-life for the knowledge gained in school of 10 years. The student, 10 years from graduation would have half the information learned in school being obsolete. Poirot (1993), CH2M Hill Chairman Emeritus, estimated that within his company the half-life was close to three years. The half-life estimates according to Muench (2006) have major assumptions, such as comparisons to other industry professionals, made so the accuracy is not dependable. Muench (2006) concluded that self-directed continuing education programs – such as online courses or webinars – would be the best solutions for educating engineers in the future.

Not all states have created a mandatory continuing education program for architects or engineers to maintain their license. In 1992, when the American Institute of Architects voted to create a mandatory program for its members, only two states had mandatory continuing education programs (Kane, 2000). As of 2012 there were 34 states with some kind of continuing education credit requirement to maintain an architect license in that state (Kaplan, 2015). More than half the states in the U.S. have created mandatory continuing education programs. These mandatory programs make it more important than ever for organizations and companies, such as AIA, to create accessible and quality courses. Since many architects and engineers hold licenses in multiple states, it is likely one of the licenses will be held in a state with a mandatory continuing education program. Within AIA in 2000, the average architect held as many as four different state licenses (Kane, 2000).

Along with architects, engineers are now required by about two-thirds of all states to complete professional development units (Teschler, 2010). The PDH are not the equivalent of the continuing education unit, but Table 9 shows the conversion used. Courses can follow the NCEES, or for international credits the courses can follow the International Association for Continuing Education and Training (IACET) (Teschler, 2010). Online courses are becoming more utilized as engineers prefer watching a webinar from their office rather than spending time traveling to conference rooms listening to a seminar (Teschler, 2010). Muench (2006) found the engineering continuing education system to be mostly based on instructor-led classroom training, which does not adequately meet the demands of the engineer population.

Previous Research

Broad background

Engineering

Looking at the educational gaps of engineers the literature has found that wood design and soft skills are the areas lacking in engineering school graduates. In 2004, a Structure magazine article, written by Craig Barnes, presented a curriculum for structural engineers that did not include any class on management, communication, or teamwork (Barnes, 2004). This curriculum was designed by structural engineers and overseen by the Structural Engineering Institute Business Practice Committee to make sure the basics of engineering are taught. A survey of all colleges and universities with structural engineering degrees found that only 40 percent of the respondents offer the entire curriculum presented in the article (Barnes, 2004). Even with 60% of colleges and universities who responded not teaching all the basics of engineering to students, the literature points out that the four year degree needed to become an engineer does a good job of preparing future engineers for the technical side of the profession. The same literature does show that it does not teach the managerial side pertaining to communication, interpersonal relationships and planning well (Stukhart 1989, Rugarcia et al. 2000). Engineering professional have a need for education beyond that of the technical knowledge needed to perform an engineer's daily duty (Stukhart, 1989). The technical knowledge of engineering is taught well in the higher education arenas but the soft skills, such as team work and communication, are not taught as well. Ahn et al. (2012) found from a study of 100 construction industry recruiters that the key competencies that recruiters look for in recent construction engineering graduates are an ability to deal with ethical issues, problem-solving and interpersonal skills. In the position paper by Cramer et al. (2008) it was pointed out that North American universities have pressure to add more interdisciplinary breadth and soft skills. Peschges and Reindel (1998) also identified team work, communication, creative abilities and ability to see different viewpoints as soft skills needed by construction engineers. A study done in Australia of engineers in mechanical, chemical, aeronautical, materials, civil, structural, environmental, geotechnical, electrical and software showed the same soft skills of communication, teamwork and problem solving as key competencies for graduating engineers (Male et al. 2009).

Similarly, wood design is often not included as part of the curriculum, making wood design a potential knowledge gap for engineers (Barnes 2004, Gupta 2005, Woods et al. 2000). As presented earlier, a curriculum for structural engineers has been created to help make sure that the basics of the engineering profession are taught. In that curriculum there is only one term or semester allotted for wood design. Most civil and structural engineering programs in the nation do not have any wood design classes (Barnes 2004, Gupta 2005, Testa and Gupta 2004). The American Society of

Civil Engineers sponsored surveys done in 1978, 1984, 1989, 1994 and 2008 that examined status of the wood design courses in civil engineering programs at colleges and universities. In the 1994 survey, only 9 percent of the students were required to take wood design courses (Testa and Gupta 2004). Considering that 80 to 90 percent of all residential structures in the U.S. are wood (by volume), and the hope of growing the non-residential market, the value of education regarding wood becomes apparent. The non-residential construction is also seeing a raise in cross laminated timber popularity. Cross laminated timber is a product developed in the early 90s in Switzerland and can be used as floors, walls or roofs for mid-sized structures (Cross Laminated Timber). As a new product in the market educating engineers on how to design and build with cross laminated timber to help bring it into the market. Wood is used more than any other material in construction so universities should be providing courses about wood (Gupta, 2005).

Williamson et al. (2009) discusses four main topics, wood's image, design methodology, university education and lack of ease of use, as the main topics keeping wood out of non-residential construction. Engineers noted that wood is not seen as a modern material or engineered for non-residential construction, while steel and concrete have the modern image. Recommendations from the surveyed engineers included providing a generic sales kit and a better system for communicating with engineers. Design methodology for engineers is trending towards load and resistance factor design for concrete and steel, while wood is behind in the methodology causing increased difficultly when designing structures of mixed materials (Williamson et al.

2009). The need to simplify the design procedures would help engineers feel more comfortable in the designing of wood structures for non-residential construction. Williamson et al. (2009) also found universities lacking in courses for wood design in civil engineering departments in the state of California. Engineering firms that do use wood will often teach incoming engineers about wood design. This does not help spread wood knowledge to the total population of engineers. The engineers surveyed agreed that increasing education hours in universities on wood design is key in spreading the knowledge. The final topic discusses wood being viewed as hard to use due to designing with complex connections compared to other materials (Williamson et al. 2009). Engineers suggested creating software that can handle the complex design that is used for steel and concrete. Simplifying and creating study aids to help convey and the complex design issue of non-residential construction would help engineers.

Architects

The literature explains a disconnect between academia and practicing architects when it comes to sharing knowledge. New advancements made about wood are not finding its way to practicing architects in comparison to other building material advancements. (Williamson et al. 2009). Formal education and on the job training is important in architecture, as it is a constantly changing profession where architects must constantly be looking to learn (Wauters 2012, Heylighen and Neuckermans 2002). Formal education beyond a four year degree, including design theory and material science, does not consistently reach practicing architects (Neuckermans, 2002) leaving many practicing architects as generalists or specialist through specialized training outside of their formal education. Practicing architects and academic researchers do not communicate effectively among each other, leading to an under utilization of academic research (Watson and Grondzik, 1997). The formal education and on-the-job training is like many other professions, that skills are accumulated as you practice. One difference lies in the special knowledge architects must master to meet client expectations which are unique to each client. Another difference is a strong understanding of regulations which are constantly evolving and differ based on the context of the project (Wauters, 2012). KnowledgeNet created by AIA is a place for professionals across architecture—from academia and industry—to communicate and spread their unique knowledge. KnowledgeNet helps bridge the gap that Heylighen (2008) found between academia and the practicing architect. Sustainability is a topic that has been researched well but the information learned is not making it to practicing architects, which led Heylighen (2008) to shift from academia to on-the-job training for practicable knowledge.

One area of knowledge in which architects lag behind is in sustainability of structures (Heylighen, 2008). Heylighen (2008) sees architects as lagging behind in sustainability design but educators have been working to add education around the topic (Iulo et al. 2012). Cortese (2003) found architectural education around environmental and social impact as topics that would be seeing more importance in the near future. Just as it is for engineers, it is critical for architects to continually seek education in the most recent advances in architecture. The formal training from a four year degree is an important step for architects to have a strong foundation but as

Wauters (2012) stated, architecture has a wide variety of special knowledge that must be gained after entering the profession. Iulo et al. (2012) found US architectural programs addressing sustainable education in 4 ways: 1) core value: all courses content addresses sustainable design; 2) systems-focused: support courses fulfill needs for sustainable education; 3) choice: sustainable education is through student selection of courses offerings; and 4) specialization: sustainable education is a specialty endeavor mainly at the graduate level. Most programs followed the specialization model providing graduate degrees to specialize in sustainable design. As academia moves sustainability to higher importance the special knowledge Wauters (2012) views as only being gained after entering the profession could be learned during school.

Professional organizations such as AIA understand the increasing importance of sustainable design. To help inform current architects AIA produced in 2006, a report on ecological literacy in architecture education (AIA, 2006). The report discusses the efforts to increase education around sustainability, definitions of terms, and academic programs that are leading the way on bringing sustainable design to students. This report is trying to bridge the gap, to bring the academic research to practicing architects. The AIA form is a great place for the overlap to happen as it looks to help architects from both academia and real world.

Specifying

Specifying of products for construction is a key step in getting wood products into the building design or in some cases the use of materials other than wood in areas wood could be used. The designers influencing the specification of structural wood products are architects and structural engineers, with architects being slightly more important (Kozak and Cohen 1999, Gaston et al. 2001, Knowles et al. 2011). Educating these designers on innovative ways to use wood products or new wood products is important, due to woods high use in the residential sector. With more education around wood products for design professionals, specification of wood products in the non-residential sector could increase. It is therefore important to find the barriers that prevent wood products from being specified. In non-residential construction, the barriers preventing wood products from being specified are building codes, design difficulty, perceptions of shortcomings with respect to wood's performance in fires, and durability (Kozak and Cohen 1999; Bayne and Taylor 2006). Knowles et al. (2011) showed most interviewees reported that code, cost and building performance requirements are the reasons behind the selection of structural systems and that it is rarely influenced by environmental impact. Code was found to be the first determining factor followed by cost (Knowles et al. 2011). The perception of wood products as environmentally friendlier than other products are advantages architects and engineers perceive about wood (O'Connor et al. 2004) when looking to specify for non-structural applications (Knowles et al. 2011), as well as the perceived advantages of aesthetics, ease of use, availability and cost (Knowles et al. 2011, Nolan and Truskett 2000). In nonresidential construction, the leading reason wood is utilized over other materials is due to the low-cost of the product, while still meeting the performance requirements (Williamson et al. 2009). Like the previous study have used, this study will use a needs assessment to find the perception design professionals have of wood.

Needs assessment

Needs assessments are a critical tool for assessing the information gaps in an industry. It is important to step back and examine what we know and what we do not know, to help find weaknesses and strengths. Previous needs assessments in the forest product industry have investigated the companies that make up the industry and not the designers who specify use of the products. Hansen and Smith (1997) surveyed the wood product industry in Oregon and Virginia. The top educational needs for those two states were identifying new markets, sales ability, plant management/finance and product pricing. The questionnaire asked the level of knowledge and importance of each area of interest, allowing the use of the Educational Need Equation used by Bratkovich and Miller (1993), which provides a figure that represents the educational need of each respondent.

Educational Need = (Importance Rating – Knowledge Rating) * Mean Importance Rating

Figure 1 - Educational Need Equation

Importance Rating is the professionals perceived value or necessity that the area has to the ability to complete a professionals job. Knowledge Rating is the perceived level of proficiency or education of the area the professional has. Having knowledge and importance used in this equation helps identify areas of little knowledge but high importance. This equation was also used by Reeb et al. (2007) and Thomas et al. (2004) in needs assessments of the Oregon and Alaskan forest product industries, respectively.

Changing climate is pushing designers to start looking at sustainable development. The increasing economic efficiency combined with codes and protection policy is making this a reality (Sinha et al. 2013). These have pushed architects and engineers to having more need of sustainable design education to navigate the evolving green building market. The green building market currently has more than 40 green building programs in the US making it important for designers to stay up to date on guidelines and for educators to know what to teach (Sinha et al. 2013).

AIA conducted a needs assessment of its members, with 1,672 responses being collected (AIA, 2015). The survey found that architects were comfortable with technology and the use of it in practicing the profession. The surveyed members also felt that continuing education is difficult to fit into the busy schedules the members have. The results showed building science & performance, environmental and high performance design and materials and methods as the top 3 topics needed by respondents (AIA, 2015). When selecting which course to take the results showed cost and convenience of location as the top 2 answers. Referrals from colleagues were the highest result when asked where members found courses. The AIA website was second to referrals but as the survey was of AIA members only, that result is not surprising. The top formats for the continuing education was 1) short courses taught onsite at their office, 2) through the internet or 3) webinar, and self administered (AIA, 2015).

CHAPTER 3 – METHODS

Mail Survey

Data were collected through a mail survey to architects and engineers in California, Oregon and Washington. From the population, a sample frame was utilized to provide strong conclusions (Allen et al. 2009). The target population consisted of all licensed architects and structural engineers practicing in California, Oregon and Washington. The study population was obtained by purchasing a list of contacts.

Sampling

Obtaining a list of design professionals in the target population was accomplished by working with USAData to compile a list from Compass Marketing Solutions, a national compiler of consumer and business data. The list generated included licensed architects and engineers from Oregon, California and Washington. The list was filtered to remove any engineers and architects that didn’t work in the construction of buildings (i.e. electrical engineers and database architects). The list had a total of 11,809 records of architects and engineers in the three states. The breakdown by state was 4,726 architects and 4,115 engineers from California; 537

architects and 309 engineers from Oregon; and 1,084 architects and 564 engineers from Washington. The list was broken down using stratified sampling to form subgroups proportional to the total number of architects and engineers per state in the list. This was done to obtain equal representation from each state. The subgroups were defined by the state and then broken down further by profession within each state.

The survey subjects were chosen from each subgroup by systematic sampling. The records were given a numeric tag (i.e. 1, 2, 3...), so that each subject had a unique identifier. In each list a random number was selected as a starting point for subject selection. Starting at that point every other subject was taken until the required number was reached for each state for architects and engineers. This provided a sample frame of the target population (Table 1).

Table 1 – Study population selected to participate in mail survey

	Oregon	California	Washington	Total
Architects	118	1,042	239	1,400
Engineers	68	908	124	1,100

Mailing structure

The administration of the survey was conducted following a modified Dillman Tailored Design method (Dillman, 2000). Two waves of questionnaires were sent out to the subjects, with the second wave sent three weeks after the initial wave. The questionnaires were mailed with a cover letter explaining the survey and a return business reply envelope for easy return by the respondent. Each cover letter was hand signed and personally addressed. The second wave contained the same information and business reply envelope.

Questionnaire measurement

The questionnaire design was based on Hansen and Smith's (1997) work in Oregon and Virginia and Reeb et al. (2007) assessment of Oregon. Because of the differences in how architects and engineers utilize wood, there were two separate questionnaires. The questionnaires were made up of four parts: (1) Needs assessment, (2) Continuing Education, (3) Specifying and (4) Demographics. See appendix B for a complete copy of the survey.

(1) Needs Assessment

The first section of the questionnaire focused on determining the knowledge level and areas of interest important to architects and engineers. The needs assessment portion of the questionnaire was a modified version of the needs assessments done by Hansen and Smith (1997), Reeb et al. (2007) and Thomas et al. (2004), in which the overall structure was left intact, but the areas of interest were changed. The structure of rating a respondent's knowledge and importance was left so that the Education Need Equation could be utilized (Figure 1). The areas of interest that were used in this questionnaire section were decided upon by the researchers and reviewed by the Forest Business Solutions group at OSU to ensure complete coverage of topics. Previous literature was used to select the areas of interest, but given differences in previous needs assessments regarding wood design that had been conducted on architects and engineers areas outside of the previous literature were used. The areas of interest were slightly different between the architect questionnaire and the engineer questionnaire due to the different aspects of the wood construction they deal with. The level of knowledge was measured using a one to five scale with 1 being "No Knowledge' and 5 being "Strong Knowledge". A one to five scale was also used for importance of wood knowledge with 1 being "Not Important" up to 5 "Very Important."

Table 2 – Needs assessment example questions

OVERALL KNOWLEDGE OF....	Knowledge	Importance
Structural wood?	1 2 3 4 5	1 2 3 4 5
LEED?	1 2 3 4 5	1 2 3 4 5
Green Certification?	1 2 3 4 5	1 2 3 4 5
Wood Species?	1 2 3 4 5	1 2 3 4 5
Wood strength and properties?	1 2 3 4 5	1 2 3 4 5
Designing with wood?	1 2 3 4 5	1 2 3 4 5
Connectivity issues with wood?	1 2 3 4 5	1 2 3 4 5

(2) Continuing Education

The second section of the questionnaire focused on continuing education of architects and engineers. The items were meant to discover what form an architect or engineer prefers taking their credits in and which avenue of search was most often used to find credits. The questions were measured by response frequency.

Table 3 – Continuing education example questions

Continuing Education

On average how many continuing education credits do you receive each year?

1-5 6-10 11-15 16-20 21-25 26-30 31 or more

How many are required by licensing stipulations?

____

Of the credits you obtained in the past 3 years, how many focused on wood?

1-2 3-4 5-6 7-8 9 or more Don't Know

(3) Specifying

The third section covered three different topics. The first topic was which characteristics of wood matter to architects and engineers when specifying a product. The questionnaire provided multiple possible choices for the design professional to choose between, with the professional able to choose multiple answers. The second topic was the impact and importance of environmental topics. The impact and importance of the environment, forest certification and formaldehyde were measured with one to five scales. For impact, the scales were measured with 1 being "Does Not Impact" and 5 being "Strong Impact" on specifying. The importance scale went from 1 being "Not Important" up to 5 being "Very Important" for specifying. The last topic was what the main wood products specified and their biggest challenges to specifying wood are. The survey questions to answer this provided multiple possible answers that the design professional could choose.

Table 4 – Specifying example questions

Specifying wood
What characteristics of wood matter when specifying for structural use?
Durability Strength Size Appearance Species
Cost Availability
What characteristics of wood matters when specifying for non-structural use?
Durability Strength Size Appearance Species
Cost Availability

(4) Demographics

The final section was composed of questions to define the respondents. Architects and engineers were asked in which states they were licensed, how long they had been practicing and what kind of building projects they work on. These were measured by number of respondents to select an answer.

Table 5 – Demographics sample questions

Demographics
State Licensed in?
Oregon Washington California Idaho Nevada Colorado Other______
How long have you been a practicing architect/engineer?
1-5 6-10 11-15 16-20 21-25 26 or more

The completed questionnaire was then pre-tested by having three engineers and three architects complete the questionnaire. The pre-test subjects were found by asking contacts in the architecture and engineering professions to provide possible candidates. The results from the pretest and review found the questionnaire easy to understand and relevant to the target audience. Only four wording changes were suggested by the pre-test subjects and all four were made.

Analysis

(1) Needs Assessment

The needs assessment data was analyzed by taking each area of interest and finding the mean rating for all respondents. The mean was calculated for the perceived knowledge level and importance level for architects and engineers. The mean ratings were then placed into the Educational Needs Equation to determine the level of education needed compared to the rest of the areas of interest.

(2) Continuing Education

The continuing education data was analyzed by tallying the frequency of times an answer was selected. The percentage was found by taking the frequency that an answer was selected and dividing it by the total number of respondents. This provided the percentage of respondents that selected an answer, with the highest percentage being the answer used by the most respondents.

(3) Specifying

The characteristics of wood that matter when specifying and what the biggest challenges to specifying wood data are were analyzed by tallying the frequency of times an answer was selected. The percentage was found by taking the frequency that an answer was selected and dividing it by the total number of respondents. This provided the percentage of respondents that selected an answer, with the highest percentage being the answer used by the most respondents.

(4) Demographics

All demographic questions were analyzed by tallying the frequency of response for each answer. The percentage of respondents that selected a given answer was then found.

CHAPTER 5 – RESULTS

Response Rate

The adjusted response rate of the questionnaire was 9.63% (Table 6). The questionnaire was sent out to 2,500 designers, with 486 of the questionnaires being undeliverable. This gave the survey an adjusted total of 2,014 designers surveyed. By profession architects' adjusted total was 1,122 and engineers' adjusted total was 893. The adjusted response rate was found by the number of responses (194) divided by the adjusted number of non-responses (2,014) to get 9.63%.

Table 6 – Questionnaire response rate

	Architects	Engineers	Total
Questionnaires Sent	1,400	1,100	2,500
Undeliverable questionnaires	278	208	486
Adjusted Total	1,122	892	2,014
Total responses	134	60	194
Adjusted response rate	11.95%	6.72%	9.63%

When broken down between architects (11.95%) and engineers (6.72%), the adjusted response rate from architects was higher. This could be due to a portion of the engineers not using wood as a building material due to the requirements of codes prohibiting it from structures they work on. The total responses between professions had architects respond 134 times and engineers 60 times. The non-response bias was unable to be found, as the purchased list did not contain phone numbers, removing the ability to perform follow-ups to the non-respondents.

Architect Results

Wood design

According to the results presented in Figure 2, 48% of responding architects perceived themselves as having above average knowledge of wood design. The results also show that 25% of the 128 responding architects perceived they had strong knowledge of wood design, which is the second highest frequency. It is important to note, only ten respondents viewed themselves as having some knowledge or no knowledge of wood design.

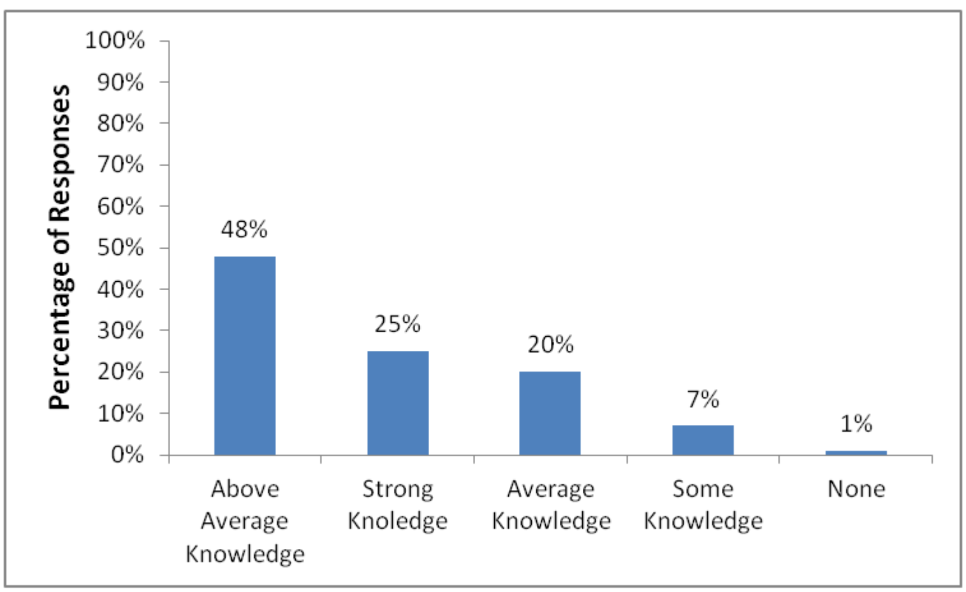

Figure 2 – Percentage of total responses regarding the level of knowledge of wood design (Architects)

The mean results of all areas of interest with regards to knowledge level (Figure 3) shows that the responding architects in general feel that they have an average to above average knowledge level in all but three topic areas. The three areas of interest that were ranked lower than average knowledge were Green Globes, 2012 Changes to LEED and Forest Certification. It is important to note that these three areas of interest are not directly involved in desiging wood structures but instead are areas of interest that deal with the environmental impact of wood. The means across all the remaining areas of interest are relativly the same, showing responding architects have a precieved broad knowledge.

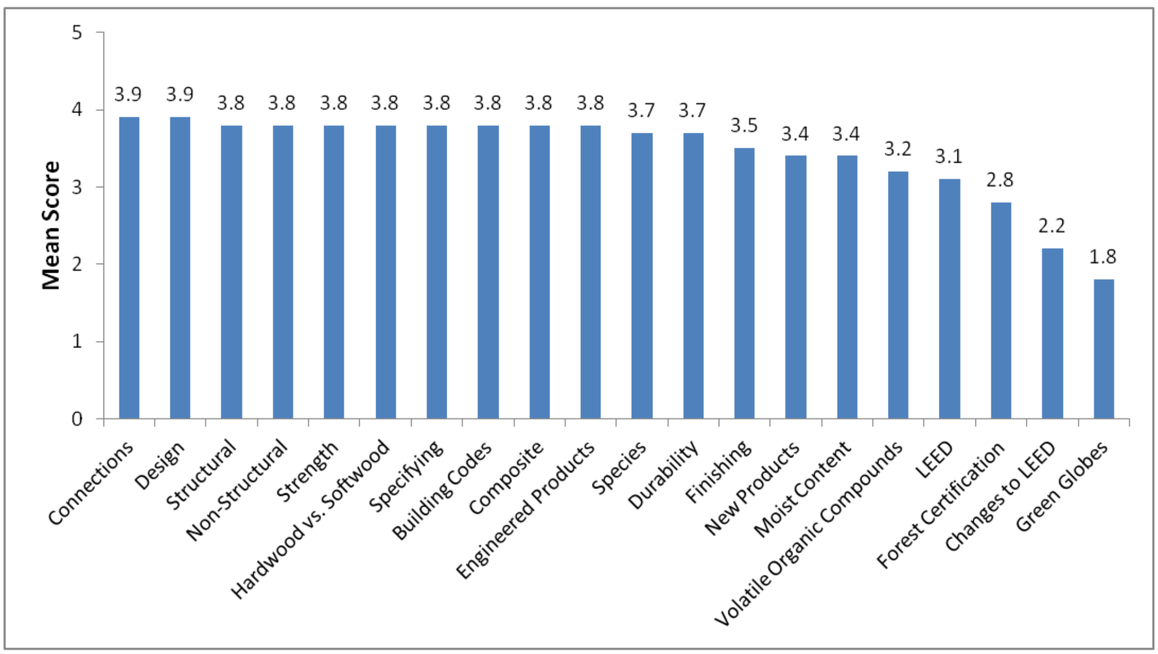

Figure 3 – Mean score of responses regarding the Knowledge of Areas of Interest (Architects)

Education need

According to the results, responding architects have a positive educational need in all areas of interest but hardwood vs. softwood, meaning that there is a need to improve the knowledge in all the other areas to some degree (Table 6). The responding architects rated themselves having an above average level of knowledge as seen in Figure 3, in all but 3 areas of interest, but when looking at both knowledge and importance, changes to LEED becomes the area of interest that rates as both high in importance and below average on knowledge. The top 4 areas of interest as seen in Table 6, are areas that responding architects perceives as important and have low knowledge in. The remaining areas show responding architects as perceiving they average or above knowledge and when combined with the perceived importance the areas do not need more education. With the remaining areas of interest, except hardwoods vs. softwoods, it is important to note that the education need is above 0 and below 2; meaning a small gain in knowledge will meet the level of knowledge needed due to the importance of the areas of interest.

Table 7 – Average Educational Need rating of Architects

Architects		
Areas of Interest	Mean	Rank
CHANGES TO LEED	2.27	1
NEW PRODUCTS	2.15	2
MOISTURE CONTENT	2.13	3
DURABILITY	2.03	4
FINISHING	1.82	5
BUILDING CODES	1.73	6
VOLITIALE ORGANIC COMPOUNDS	1.67	7
STRUCTURE	1.66	8
ENGINEERED PRODUCTS	1.48	9
CONNECTIONS	1.44	10
COMPOSITES	1.41	11
STRENGTH	1.37	12
WOOD DESIGN	1.36	13
FOREST CERTIFICATION	1.31	14
SPECIFYING	1.22	15
SPECIES	0.81	16
GREEN GLOBES	0.52	17
LEED	0.30	18
NON-STRUTURE	0.25	19
HARDWOOD VS. SOFTWOOD	-0.03	20

Avenues of finding Continuing Education Courses

When asked how architects identify continuing education courses the results show Internet searches (60%) and professional organizations (57%) are the two most frequent avenues, shown in Figure 4. Professional organizations, according to the results of this question, have made an effort to help architects find quality courses that are important to the profession. The Internet is becoming an important tool in the education of architects due to an architect's ability to either access professional organization or other sites from any Internet-enabled location. Newsletters, magazines and colleagues are still important since they are still referenced by at least 20% of the respondents.

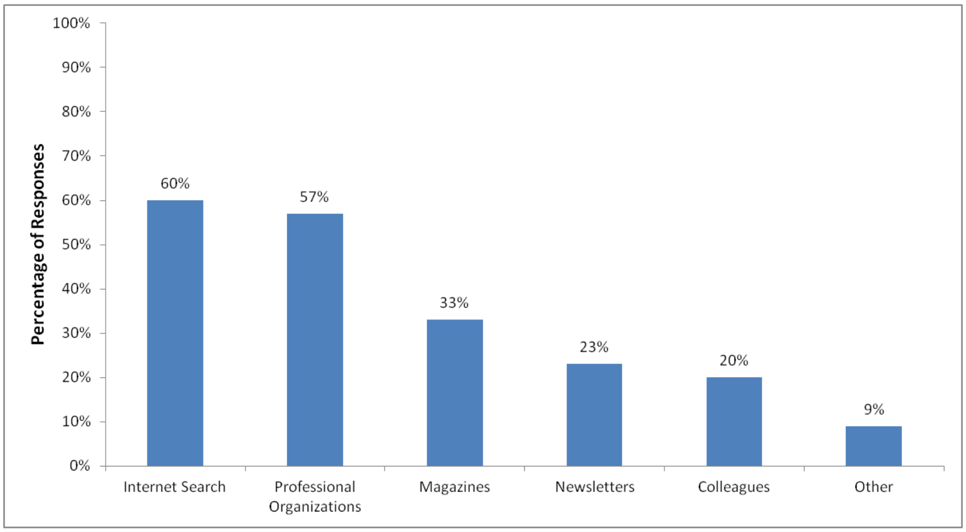

Figure 4 – Preferred avenue used to find credits by percentage of respondents (Architects)
(*Subjects could choose more than one answer.)

Methods of obtaining continuing education units

Figure 5 contains the results on the preferred form of obtaining continuing education credit. According to the results, 56% of the responding architects participate in online courses and 56% use seminars (Figure 5). The results also show that 41% of responding architects prefer lunch and learns. When comparing these results to the numbers of years practicing we see a trend that of the 22 who chose annual meetings, 17 have 21to 25 years of experience.

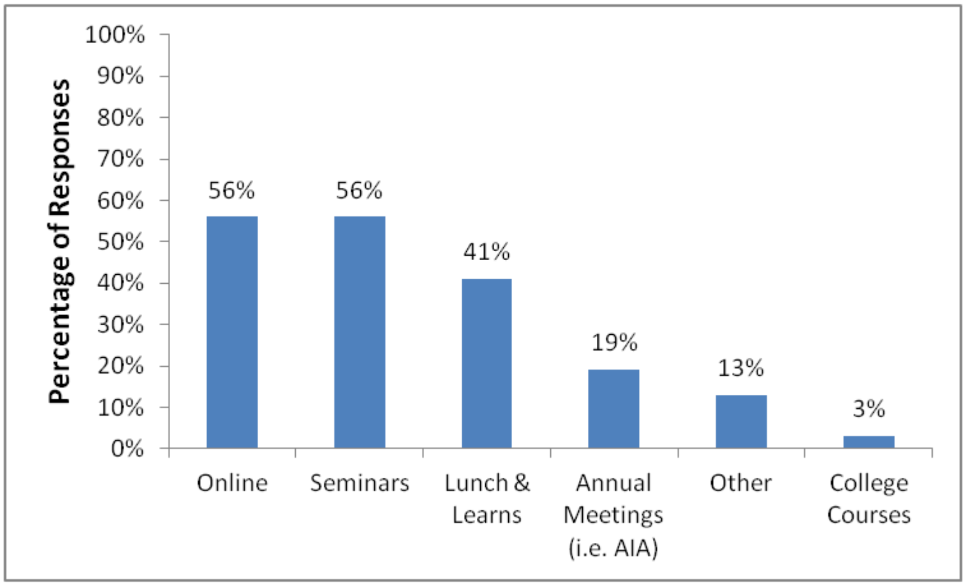

Figure 5 - Preferred sources of continuing education units by percentage of respondents (Architects)

(*Subjects could choose more than one answer.)

Barriers to specifying wood products

The results from the question of, "What is the biggest challenge to specifying wood?" showed that 50% of responding architects found cost to be the biggest challenge and 44% chose appearance (Figure 6). Looking at the top two answers and comparing the answers to years of experience, the results show 50% or more of responding architects with 26 or more years of experience selected cost and appearance. The 26 or more years experience range didn't have any other response with above 50%. It is important to recognize the connections between the different answers. Cost maybe the biggest perceived challenge, but cost could have a connection to the species as a result of it being an expensive wood to procure. Another reason cost could be seen as the biggest is due to the cost of wood compared to other cheaper alternative materials.

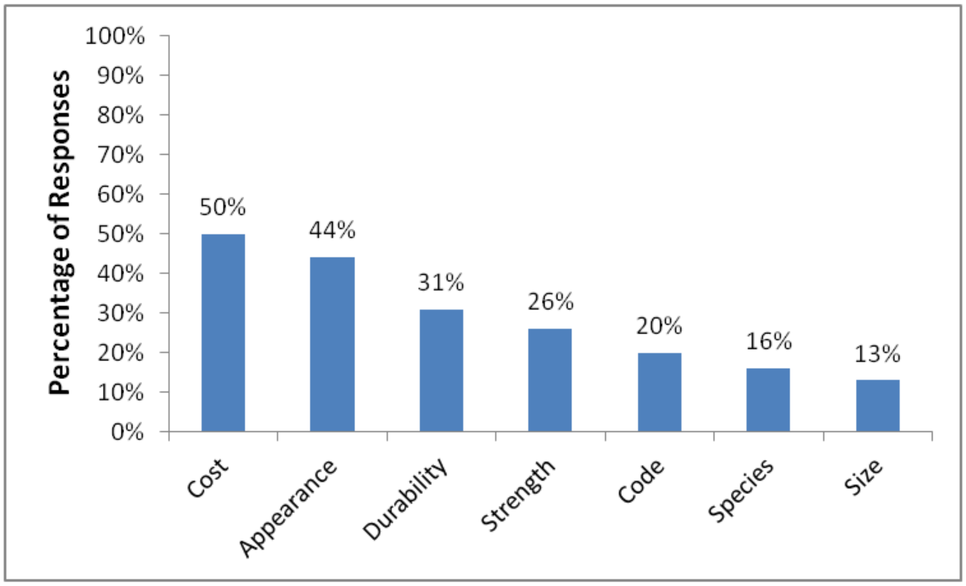

Figure 6 - Biggest Challenge to Specifying Wood Products by percentage of respondents (Architects)

(*Subjects could choose more than one answer.)

Demographics

Of all respondents 70% work on residential construction projects, 50% on commercial projects and 8% on industrial (Figure 7). All three categories have wood as a construction material, with residential using the highest volume of wood compared to other materials (Gupta, 2005).

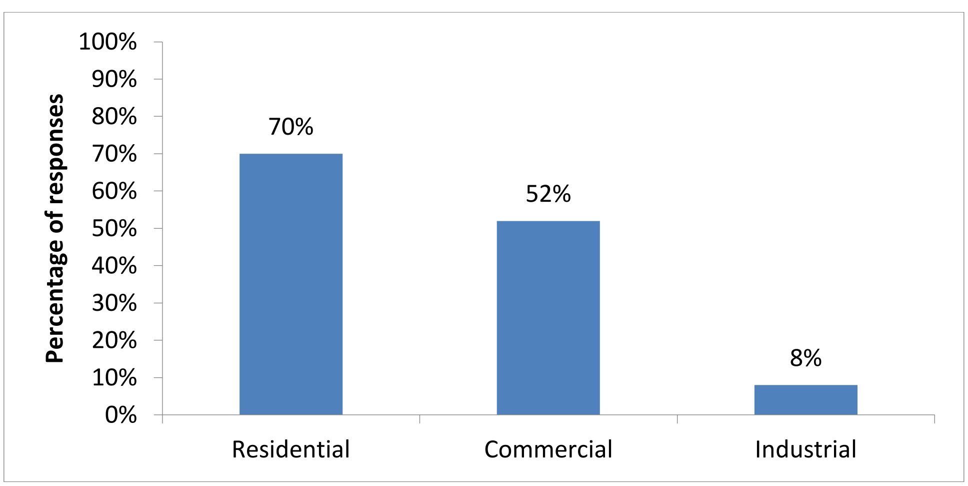

Figure 7 – Type of projects worked on by percentage of respondents (Architects)
(*Subjects could choose more than one answer.)

The breakdown of states that the responding architects are licensed in can be seen in Figure 8. The distribution of responding architects across Oregon, Washington and California is in line with the distribution of the target population by state. The majority of the responding architects have been practicing for more than 25 years (Figure 9). This is most likely because the contacts on the list from USAData were in senior level management. Due to this the results are not as representative of the target population.

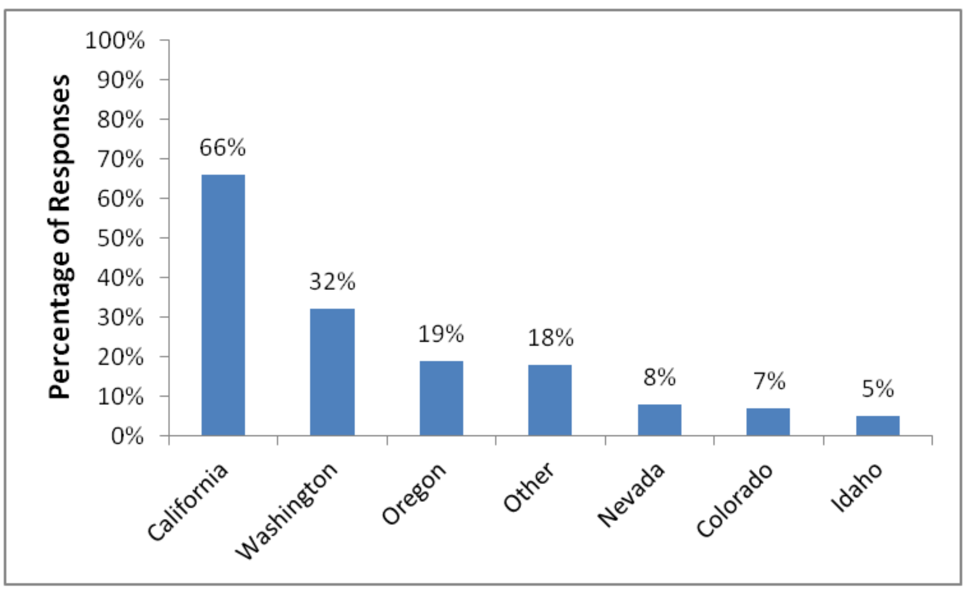

Figure 8 - Breakdown of licenses held by respondents by State (Architects)
(*Subjects could choose more than one answer.)

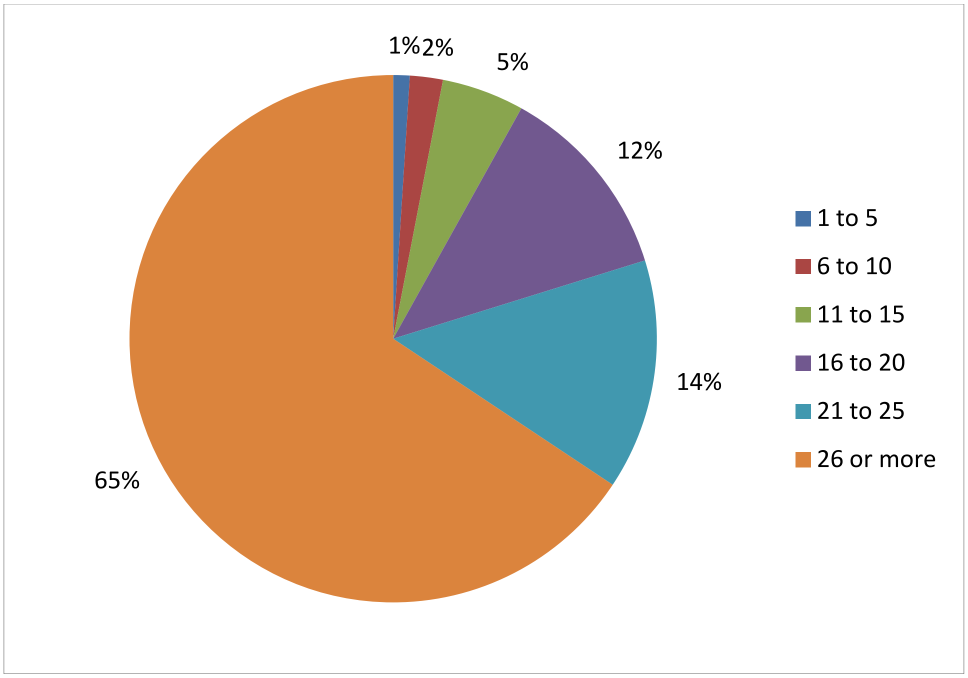

Figure 9 - Years Practicing Architecture by Respondents

Engineer Results

Wood Design

Of the engineers responding, 44% perceived having a strong knowledge level of wood design and only 11 respondents (19%) perceived having a below average knowledge of wood design (Figure 10). Of all respondents, 81% perceived having an average or higher knowledge of wood design. Seeing that 4 respondents have no preceived knowledge of wood design leads to an inference that they do not design any wooden structures.

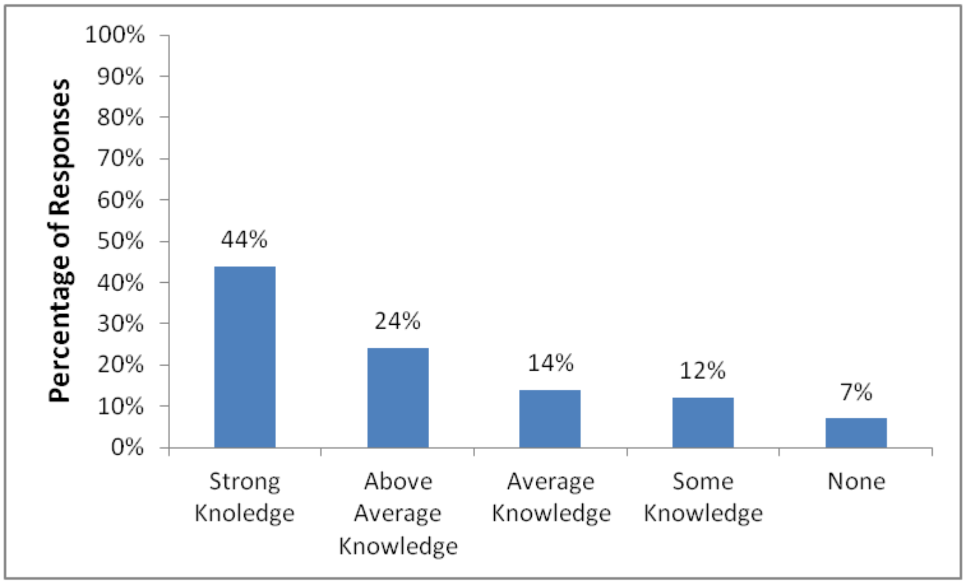

Figure 10 - Percentage of total responses regarding the level of knowledge of wood design (Engineers)

While results from responding architects showed three areas with perceived below average knowledge, results from responding engineers showed four. The four areas were LEED, Green Certifications, Finishings and Volitile Organic Compounds, for which each had an average level of some knowledge (Figure 11). These four areas do not have any connection to the strength of the wood and would not be considered in the designing of a wood structure. LEED and Green Certifications are areas of interest that deal with the environmental impact of wood.

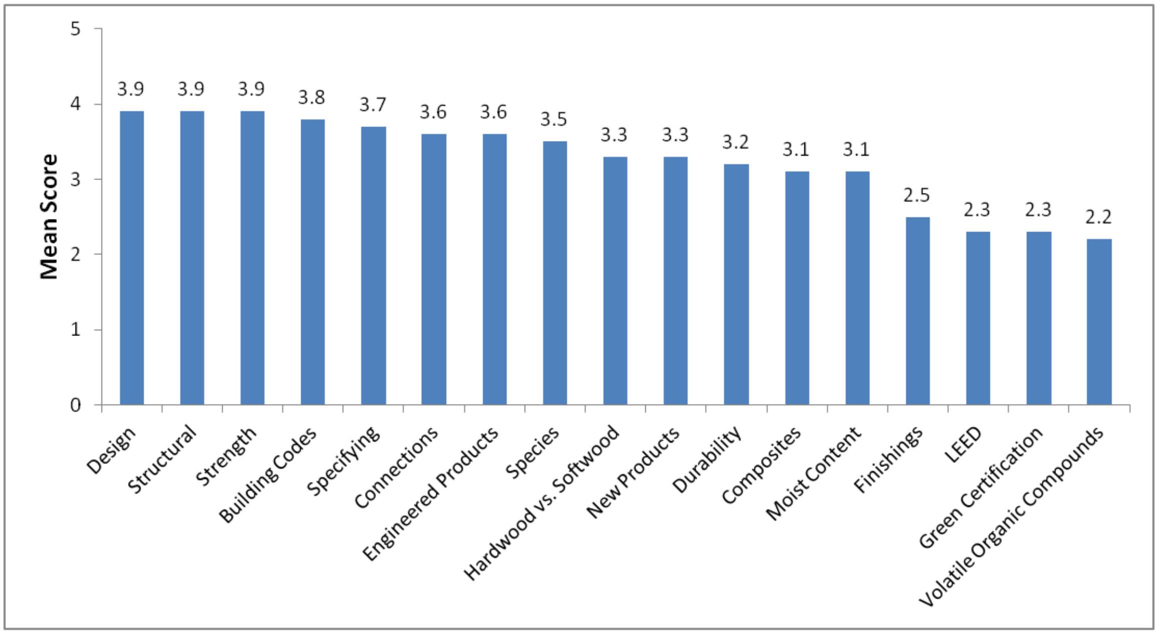

Figure 11 – Mean score of level of Knowledge of Areas of Interest (Engineers)

Education Needs

Responding engineers were found to have seven areas of interest showing a need for more education (Table 3). Two of the areas of interest were neutral, where engineers do not feel they need any more education. Eight areas of interest had more knowledge held by the responding engineers for how high of importance responding engineers perceived the areas of interest having. Specifying wood products is the area of interest with the highest need for education. The other six areas have a minimal degree of educational need.

Table 8 – Average educational need rating of engineers

Engineers		
Areas of Interest	Mean	Rank
SPECIFYING	3.7	1
VOLITIALE ORGANIC COMPOUNDS	0.4	2
NEW PRODUCTS	0.3	3
BUILDING CODES	0.3	4
ENGINEERED PRODUCTS	0.2	5
CONNECTIONS	0.2	6
COMPOSITES	0.1	7
STRUCTURE	0	8
FINISHINGS	0	9
MOISTURE CONTENT	-0.1	10
DESIGN	-0.1	11
STRENGTH	-0.2	12
DURABILITY	-0.2	13
GREEN CERTIFICATION	-0.3	14
LEED	-0.3	15
SPECIES	-0.5	16
HARDWOOD VS. SOFTWOOD	-0.7	17

Avenues of finding continuing education courses

Figure 12 shows that 61% of the respondents chose professional organizations as the main avenue of finding continuing education courses. The other tools were all close to each other, with Internet searches, newsletters, magazines and colleagues all within 12%. The results do not show how the responding engineers use the professional organizations to find the course, whether through their websites or meetings.

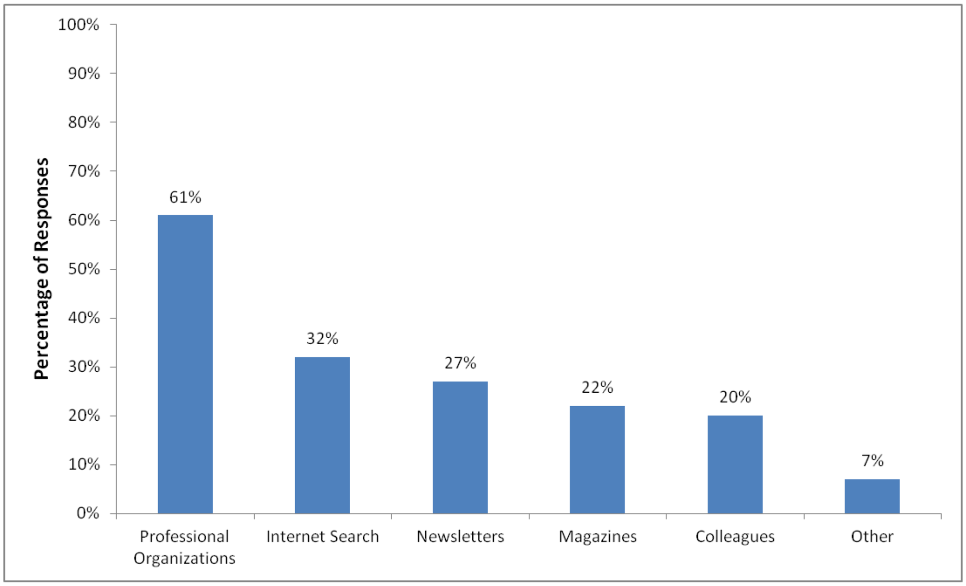

Figure 12 – Preferred avenue used to find credits by percentage of respondents (Engineers)

(*Subjects could choose more than one answer.)

Methods of obtaining continuing education units

Responding engineers prefered the more in person approach of seminars, with 75% of the respondents choosing it (Figure 13). The second and third choices were close: 37% for online and 31% for lunch and learns. Lunch and learns also support the inperson trend shown by the seminars. College courses were the least utilized method with only 3% of respondents using them.

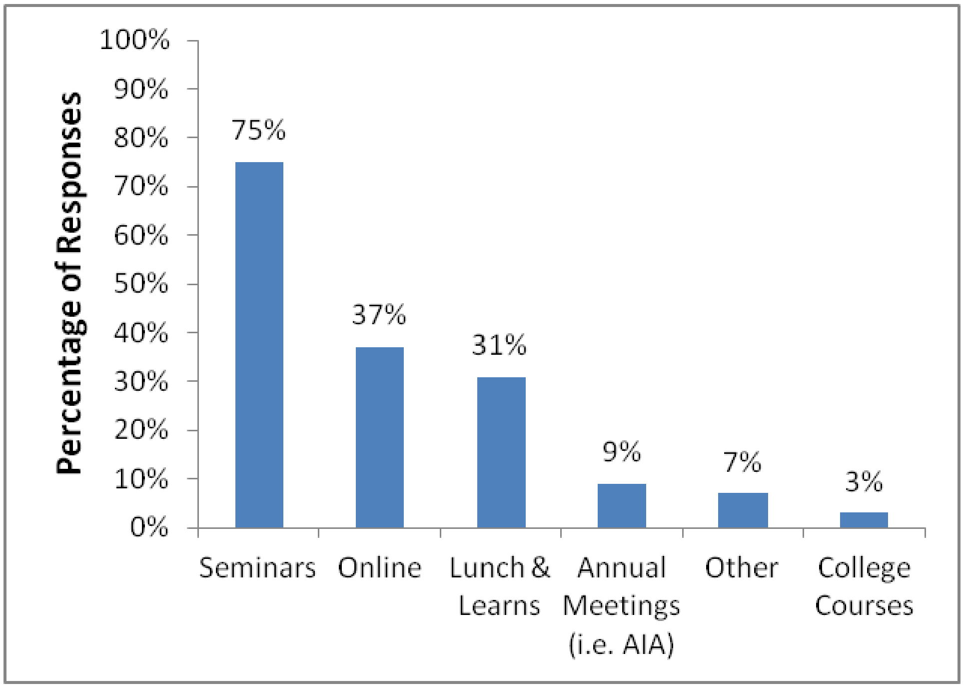

Figure 13 - Preferred sources of continuing education units by percentage of respondents (Engineers)

(*Subjects could choose more than one answer.)

Barriers to specifying wood products

Results of the question regarding barriers to specifying wood products indicated 49% choose strength as the biggest challenge. Code (20%), cost (25%), durability (17%) and size (27%) were all close to equal for the second biggest challenge (Figure 14).

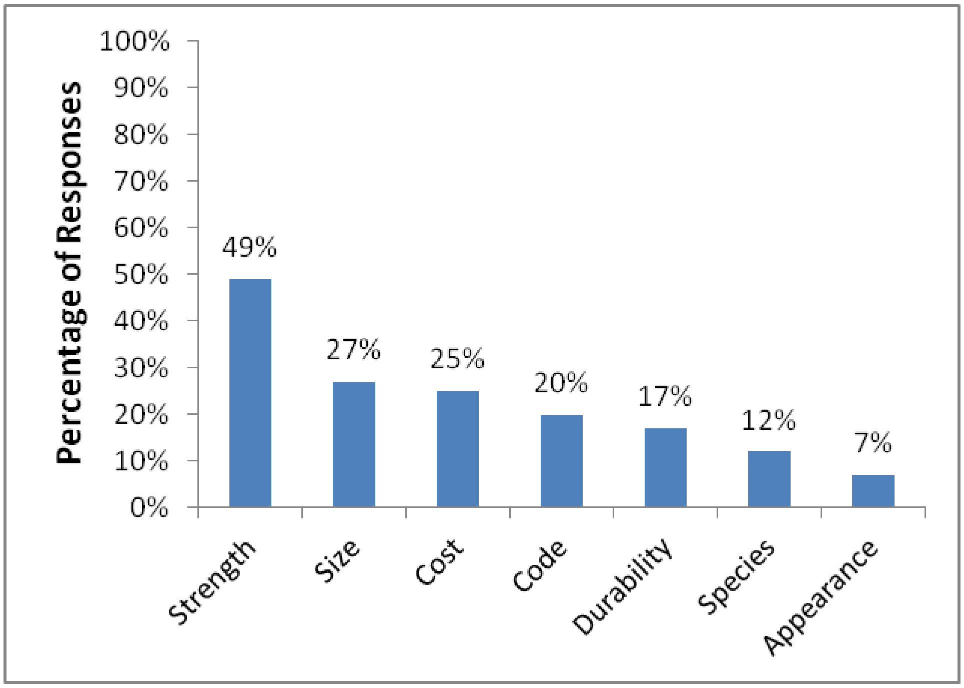

Figure 14 - Biggest challenge to specifying wood products by percentage of respondents (Engineers)

(*Subjects could choose more than one answer.)

Demographics

Of the responding engineer, 65% worked on residential, 48% commercial and 23% industrial projects (Figure 15).

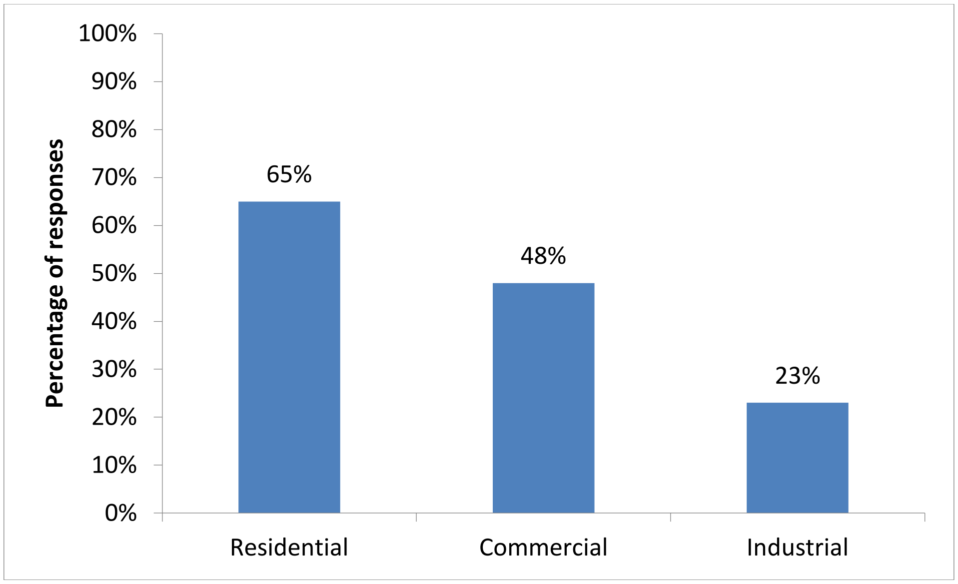

Figure 15 - Kind of Projects worked on by respondents (Engineers)
(*Subjects could choose more than one answer.)

Years of engineering practice were similar to those of architects, with most responding engineers having practiced for more than 25 years (Figure 16). The states licensed are broken down in Figure 17, showing the percentage of responding engineers holding licenses in that state. The distribution of responding engineers by state within Oregon, Washington and California does not follow the distribution of subjects surveyed. Oregon and Washington have similar number of respondents even though the target population per state was different.

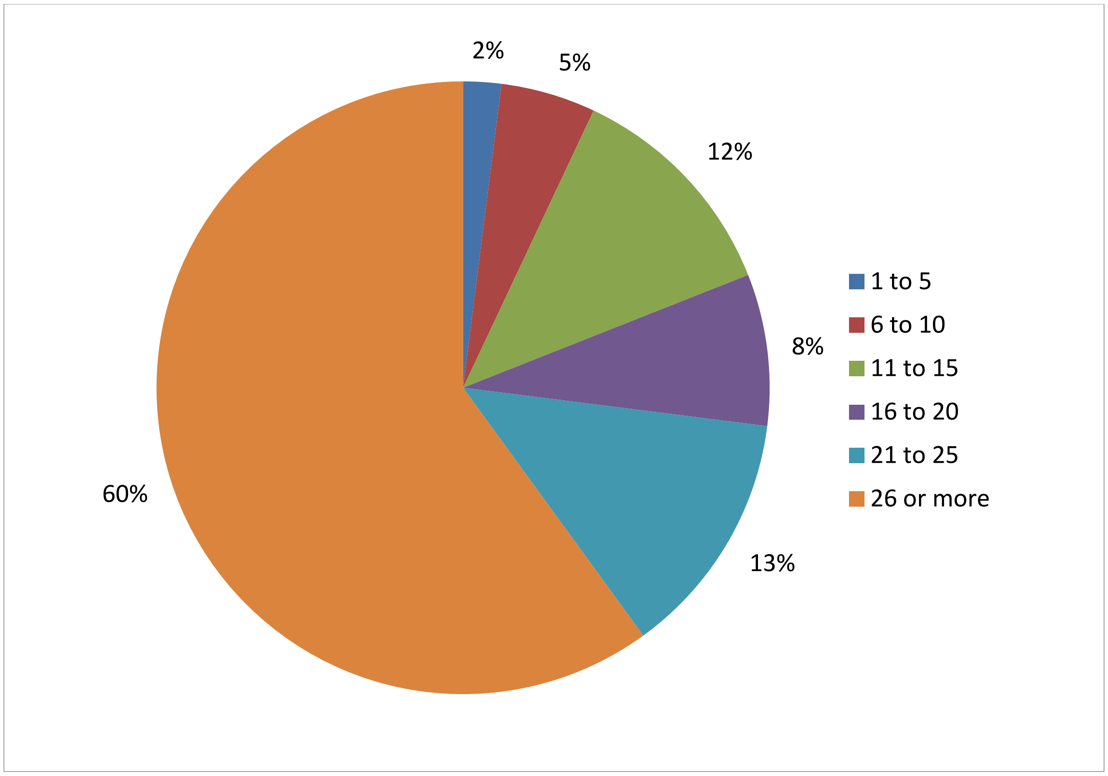

Figure 16 - Years Practicing Engineering by Respondents

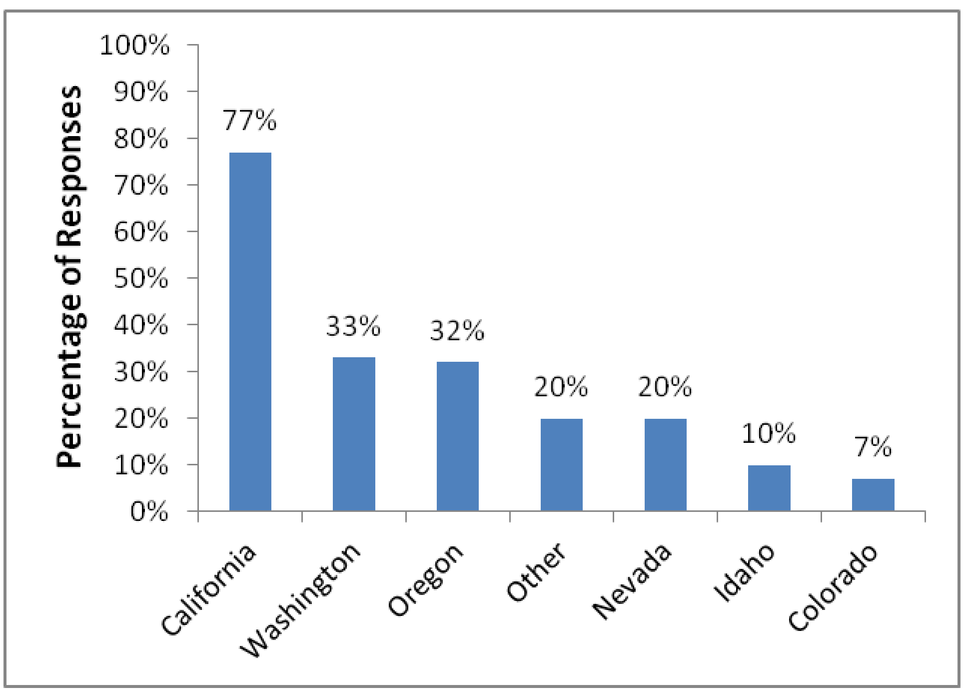

Figure 17 - Breakdown of licenses held by respondents by State (Engineers)

(*Subjects could choose more than one answer.)

Discussion

Wood design

Respondents perceived themselves to have a strong knowledge base in the technical skills associated with wood design based on the results. This result is not unexpected due to the licensing requirements of the professions. The result also agrees with the prior research done by Ahn et al. (2012) that engineers have a strong technical knowledge of engineering. This does have some interesting conflict with Gupta's (2005) work regarding the decline of wood courses in universities. These results are also based on what the respondents perceive as their level of knowledge, so it gives us a view of how respondents perceive themselves. The results of having all but seven areas of interest being average or higher knowledge level is similar to research done by Peschges and Reindel (1998) and Ahn et al. (2012) since no soft skills were asked about. The research by Peschges and Reindel (1998), Ahn et al. (2012) and Barnes (2004) showed that it was the soft skills that were not addressed in formal education and therefore are below average. The below average rating for responding engineers on LEED and green certification follows the previous research in that recruiters do not see this a key competency for engineers so they do not need a strong knowledge of the area (Ahn et al. 2012).

Education need

Responding engineers had specifying wood as the area of interest needing additional education. Engineers usually do not specify actual products but instead include specs that a product must meet to be used in the engineering solution they have created for a structure. So it is therefore not surprising that this is the highest area of interest in need of education. It could be an issue specific to wood products and not products in general since wood design is not part of all engineering degrees. Responding architects indicated a need for more education in changes to LEED, new products, moisture content and durability. The changes to LEED are new this year so it is understandable that it would be an area of interest that needs greater attention by architects. Moisture content and durability were issues that were found in previous research done by Kozak and Cohen (1999) and later by Bayne and Taylor (2006) to be barriers to the use of wood given they are possible negative attributes. This perceived barrier could be reduced with more education in the areas of interest.

Avenues of finding continuing education courses

The results agree with the previous research done by Teschler (2010) which found that online sources are being utilized more often by designers. Since professional organizations play a large part in providing access to the continuing education courses they are the main way engineers and one of the main ways architects find courses. Responding architects also utilize Internet searches as often as they use the professional organizations.

Methods of obtaining continuing education units

Responding engineers use seminars as the preferred method of taking courses. This supports the previous research of Muench (2006) that the engineering industry traditionally uses a more in-person teaching method for continuing education. Responding architects chose online continuing education and seminars as the preferred method of obtaining credits. The presence of seminars in both professions could also be due to the ability to network and talk with peers. The online tool discussed in the previous research is more of a low cost solution that can help fit credits into a busy schedule (Teschlur, 2010).

Barriers to specifying wood products

Responding engineers perceived strength as the biggest barrier to specifying wood. This follows the previous research conducted by Kozak and Cohen (1999) and later by Bayne and Taylor (2006) in which they felt it was difficult to design with wood. Strength is one of the areas responding engineers felt impeded by wood's attributes in the design of buildings. Responding architects felt the biggest issues were cost and appearance. This goes against the previous research done by Knowles et al. (2011) and Nolan and Truskett (2000), which found aesthetics and cost as perceived advantages of wood. Cost is not always an advantage as cost varies and can be a barrier when to high. Wood cost and appearance often go together with the more expensive wood being perceived as having better appearance. The barrier of cost is something that could change depending on what part of the building design architects are basing this on. The cost of wood used in the structure of the building may be considered inexpensive, while hardwood flooring can be very expensive and lead to architects specifying a different material.

CHAPTER 6 – CONCLUSION

Architect Conclusions

According to the results, responding architects have a mean knowledge rating of wood design of 3.89 with a maximum of 5, with 73% of the respondents having an above average knowledge. This leads to the conclusion that architects believe they have an above average knowledge of wood design. It can then be inferred that responding architects do not have an educational need in the area of wood design. This is supported by the 13th lowest educational need out of the 20 areas of interest looked at in the questionnaire (Table 3).

The areas of interest that have educational need are that of the top four ranked areas: changes to LEED (2012), new products, moisture content and durability. All four hold a mean educational need level of over 2.0, with the largest mean of 2.27 (Table 3). The results, when looked at with previous needs assessments that have been conducted in the forest product industry, look to be low educational need. Hansen and Smith (1997) had educational need averages of 3.39 and higher for the top 10 areas of interest. This leads to a conclusion that there are no immediate areas of interest that are lacking education.

Results show that responding architects utilize online searches and professional organizations as their preferred ways of finding continuing education courses. With these results we can conclude that courses on wood products should be made searchable online and in the database of professional organizations, such as AIA. This should help wood product courses to be more likely found by architects.

Along with being in the right places to be found by architects, wood product continuing education courses also need to be offered in the forms that architects prefer. The top two forms that were found from the questionnaire results were online and seminars, which were tied at 56%. The next closest was lunch and learns at 41%. With this data it can be inferred that the best course formats are online and seminar. However, the online format will have a wider reach since it does not require attendees to be in the same physical location. In conclusion, wood product courses should be accessible and usable online courses, which will be more available to architects everywhere.

The biggest challenge perceived by responding architects to specifying wood products was cost and appearance. These two barriers are not things that can be easily influenced or changed. Through education of what wood species and products are available, the perceived barriers of cost and appearance can be mitigated by the addition of substitutes.

Engineer Conclusions

The results of the data provide insight as to how responding engineers perceive their knowledge in areas of interest, preferences for searching for continuing education units, the form those units come in and what the barriers to specifying wood products are. Responding engineers have an average rating of wood design knowledge of 3.9. Respondents chose a rating of above average or strong knowledge in the area of wood design 67% of the time (Figure 10). With these results it is inferred that an above average knowledge is held by responding engineers regarding design using wood as a material.

Specifying of wood is an educational need of engineers with both low knowledge and high importance, giving it a high educational need rating. The mean educational need rating of 3.66 is well above the second ranking area at 0.41 (Table 4). The rating of 3.66 places it in the top five of the results found by Hansen and Smith (1997), showing this as a high educational need area compared to results found in this research but also in previous research. This provides evidence to conclude that responding engineers need education in the area of specifying wood products.

Responding engineers use professional organization as the avenue through which they prefer finding continuing education courses, with 61% of the respondents choosing professional organizations. The next closest avenue was Internet searches at 32% (Figure 12). This indicates that to have the best chance of responding engineers finding a wood products course, it should be listed with a professional organization.

The result for format of continuing education courses was clearly shown. The responding engineers preferred seminars (75%) as the continuing education method (Figure 13); therefore creating seminars for engineers to fulfill their continuing education units will have the best chance of success.

The largest barrier to specifying wood products was strength at 49%, with size being second at 27% (Figure 14). This barrier is one that can be overcome with education on new engineered wood products that have greater strength than pure wood products. This barrier may be more perceived in one form of construction (i.e., residential, commercial or industrial) than across all of them equally since residential construction tends to have small spans and weight associated with the structures.

CHAPTER 7 – FUTURE RESEARCH & LIMITATIONS

Limitations

The response rate of the questionnaire can be seen as low and calls into question the accuracy of the respondents representing the target population. This is also seen in the small number of responses in some subgroups compared to the total population they are supposed to represent. One explanation may be that the list included mainly contacts from upper management level in a company. Other surveys of architects and engineers returned results near 25% or higher.

Because not all the engineers that were respondents worked with wood as a building material the responses are not as accurate since they may not fall under the target population. The demographic of years practiced showed that the average respondent had been practicing for 26 or more years. This does not give a very good overall assessment of the professions since it did not have a good cross-section of years practicing. This can influence the results since professionals who have been practicing for 26 or more years may have different responses then professionals who have recently been licensed.

The sampling method holds a limitation due to the subgroups not being randomized prior to the systematic sampling. Since no randomization was done, then the systematic sampling of every other did not meet the sampling interval for the size of subgroups, making it so we can only generalize our conclusions to the immediate sample. By not meeting the sampling interval for the size of the subgroups it only took subjects from part of the zip codes within the state.

Non-response bias is a problem even though we cannot test for it due to the limiting nature of the list purchased. Engineers specifically may not have responded due to not working with wood. This is also a possible reason for architects to have not responded.

Future Research

This survey was conducted to help the researchers focusing on the forest product industry gain insight into what information is relevant to architects and engineers. It would be important now to start gathering the relevant information from the forest product industry and putting it in the preferred formats for continuing education. It will also be interesting to compare this research to future needs assessments to find if any changes to the results are found.

In addition it would be interesting to find out what the educational needs are of recent graduates and recently licensed architects and engineers. This would help give a better overall picture of the professions than just what this survey accomplished. Most importantly, future surveys should obtain respondents' actual versus perceived knowledge.

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APPENDICES

Appendix A – Tables, Figures

Table 9 – Board Standards

- Graduation from an EAC of ABET accredited engineering program.
- Graduation from a TAC of ABET baccalaureate engineering program.
- Graduation from an ACCE accredited four-year baccalaureate construction engineering management program.
- Graduation from a graduate degree program in engineering at a college or university that has an EAC of ABET accredited undergraduate degree program in the same field as the graduate degree program, combined with completion of 21 semester/32 quarter hours of engineering related technical course work.
- Graduation from TAC of ABET accredited two-year Engineering Technology program or graduation from a two-year Associate of Applied Science program in Engineering Technology that includes the following:
    - A total of at least 64 semester/96 quarter hours.
    - At least 32 semester/48 quarter hours in technical courses. (Skills and knowledge of appropriate methods, procedures and techniques; experience in carrying out established engineering procedures).
    - At least 16 semester/24 quarter hours in math and science, including:
        - 4 semester/6 quarter hours in basic science (physics, chemistry, earth and life sciences)
    - 8 semester/12 quarter hours in mathematics (not including courses below the level of college algebra or courses in computer programming).
    - At least 9 semester/13 quarter hours in social science, humanities and communications.
    - In addition to the educational requirements, graduates from two-year programs shall complete two or more years of engineering work before qualifying to take the FE examination for enrollment as an EI. In the alternative, graduates from two-year programs may complete additional course work consisting of 21 semester/32 quarter hours in Differential Equations, Physics, Statistics, Statics, Dynamics, Thermodynamics, Fluid Mechanics, Electrical Fundamentals and Strength of Materials.

Table 10 – Activities Suggested by Board for CPE Hours

- CPE hours in attendance at short courses or seminars, sponsored by colleges or universities.
- CPE hours in attendance at technical presentations in HSW subjects related to the practice of architecture which are held in conjunction with conventions or at seminars related to materials use and function.
- CPE hours acquired in structured self-study courses dealing with HSW subjects related to the practice of architecture.

- A maximum of three CPE hours may be claimed as preparation time for each class hour spent teaching architectural courses or seminars in HSW subjects. College or University faculty may not claim CPE hours for teaching regular curriculum courses.
- CPE hours spent in architectural research in HSW subjects and has been published or formally presented to the profession or public.
- Reading designated articles or completing structured coursework in HSW subjects found in architectural journals or on web sites and receiving a certificate of completion issued by the provider. The professional journal articles dated before two years prior to the date of testing will not be allowed as acceptable CPE.
- Taking and passing college or university credit courses in HSW subject matter and dealing with architectural subjects. Each semester hour of credit awarded by the college or university each term will equal 15 CPE hours. Each quarter hour of credit awarded by the college or university each term will equal 10 CPE hours.
- CPE hours spent in professional service to the public which draws upon the registrant's professional expertise on boards and commissions that are charged with the protection of the health, safety, and welfare of the public.

Table 11 - Activities not approved by the Board

- Time spent on the same CPE, even if obtained on different dates, may be used only once during a renewal period to meet the renewal/CPE requirements.
- Time spent in unstructured programs or self-directed study.
- Time spent on architectural educational tours of cities, buildings, or public places, unless there is a significant HSW component to the tour curriculum.
- Time spent as a mentor for a person enrolled in the IDP program.
- Time spent in any teaching program sharing professional skills, such as the Architects in Schools (AIS) program.

The exemptions for architects to not meet the CPE hours are as follows:

- Has served honorably on active duty in the military service;
- During the full period covered by this Board's renewal, the architect was actively registered as an architect in another Board-recognized jurisdiction that has a mandatory CPE requirement for renewal of an architect's registration;
- Special Exemption -- The board shall have authority to make exceptions for reasons of individual hardship, including health (certified by a medical doctor) or other good cause. The architect must provide any information requested by the Board to assist in substantiating hardship cases. This exemption is granted at the sole discretion of the Board.

Table 12 - Non-qualifying activities (other activities at Boards discretion)

- Regular employment
- Real estate licensing courses

- Personal, estate, or financial planning
- Personal self-improvement
- Service club meetings or activities
- Equipment demonstrations or trade show displays
- Topics not relevant to engineering
- Enrollment without attendance at courses, seminars, etc.
- Repetitive attendance at the same course
- Repetitive teaching of the same course
- Attending committee meetings or general business meetings of any organization
- Taking professional or required examinations

Table 13 - Qualifying activities (non-comprehensive list)

- Successful completion of college courses
- Successful completion of short courses, tutorials, correspondence, web based courses, televised and videotaped courses
- Active participation in seminars, in-house courses, workshops, and professional conventions
- Teaching or instructing a course, seminar, or workshop one time only
- Authoring or co-authoring published papers, articles or books (Maximum of 10 PDH units per biennial renewal period)
- Active participation in professional or technical society, committee, or board (Maximum of 8 PDH units per biennial renewal period)
- Self-study (Maximum of 6 PDH units per biennial renewal period)
- Mentoring of engineering topics to a nonregistered individual not under your supervision (Each 10 hours spent mentoring equals 1 PDH unit, Maximum of 4 PDH units per biennial renewal period)
- Non-technical educational activities related to the registrant's employment
- Developing, writing, or scoring an engineering examination for licensure or certification (Maximum of 15 PDH units per biennial renewal period)

Table 14 - The conversion of other units of credit to PDH

- 1 College Semester hour equals 45 PDH
- 1 College Quarter hour equals 30 PDH
- 1 Continuing Education unit equals 10 PDH

Table 15 – States based on Continuing Education Program

Mandatory Continuing Education Program	No Mandatory Continuing Education Program
Alabama	Alaska
Arkansas	Arizona
Washington DC	California

Delaware	Colorado
Florida	Connecticut
Georgia	Maine
Hawaii	Michigan
Iowa	Montana
Idaho	North Dakota
Illinois	New Hampshire
Kansas	Nevada
Kentucky	Utah
Louisiana	Virginia
Massachusetts	Washington
Maryland	Wisconsin
Minnesota	
Missouri	
Mississippi	
North Carolina	
Nebraska	
New Jersey	
New Mexico	
New York	
Ohio	
Oklahoma	
Oregon	
Pennsylvania	
South Carolina	
South Dakota	
Tennessee	
Texas	
Vermont	
West Virginia	
Wyoming	

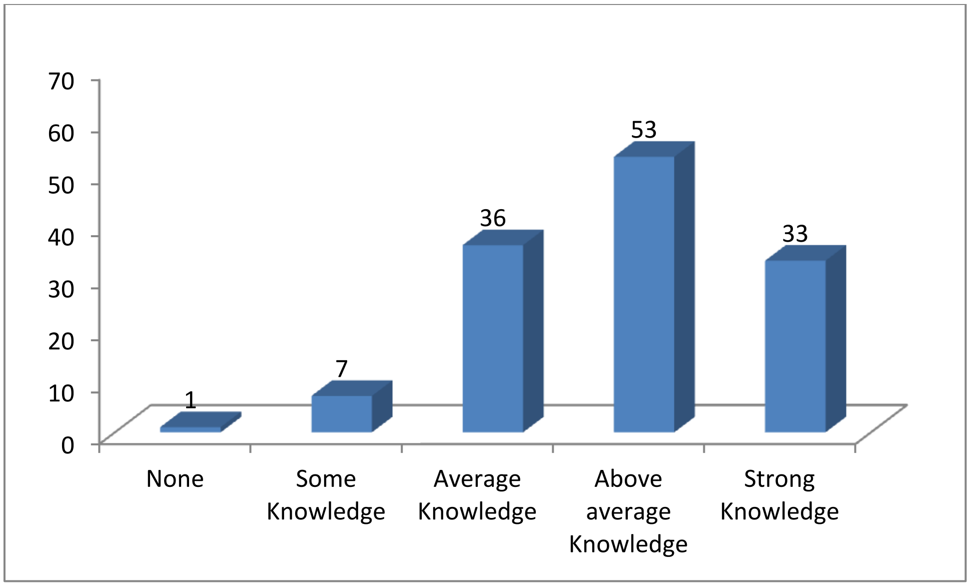

Figure 18 - Frequency of responses regarding the level of knowledge of structural wood products (Architects)

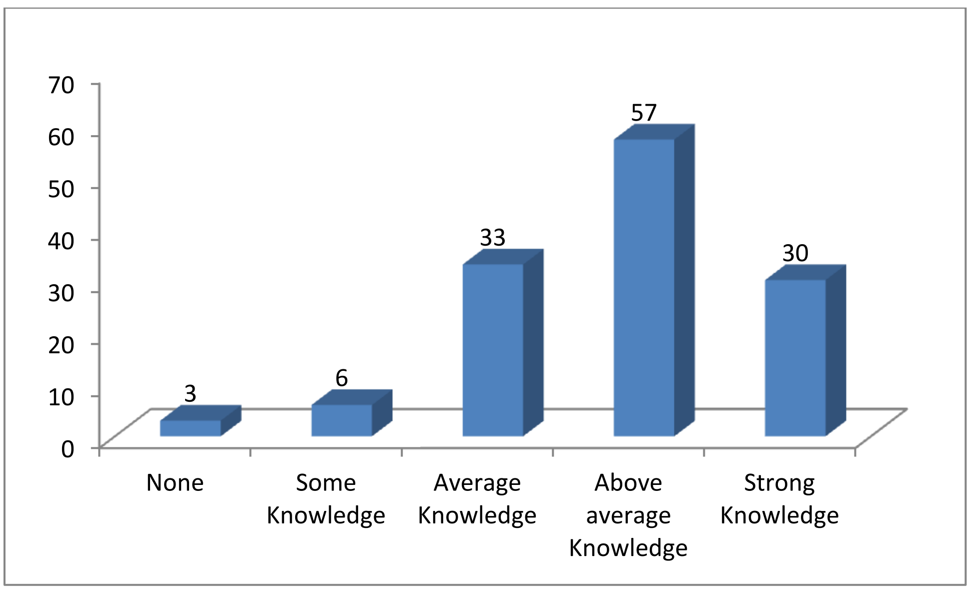

Figure 19 - Frequency of responses regarding the level of knowledge of on-structural wood products (Architects)

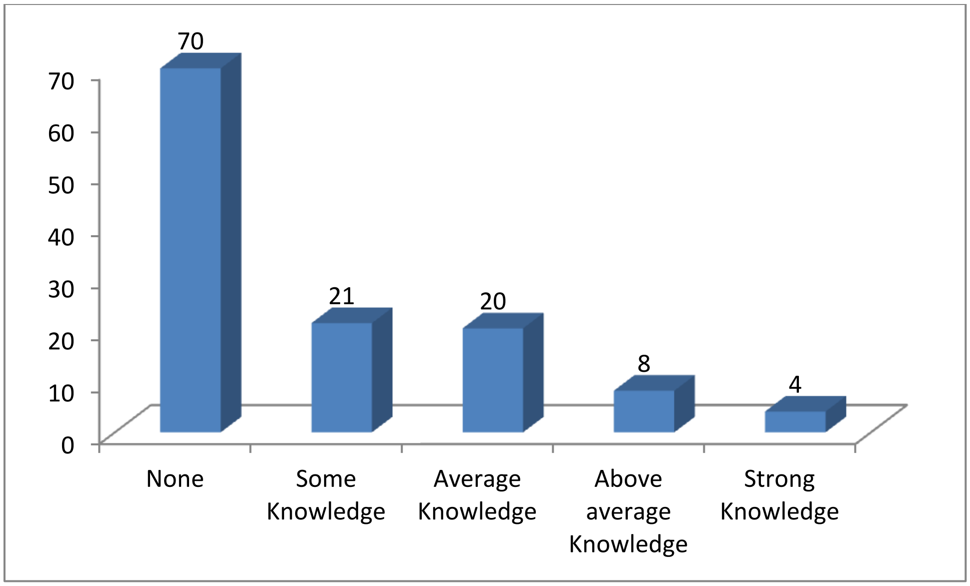

Figure 20 - Frequency of responses regarding the level of knowledge of Green Globes program (Architects)

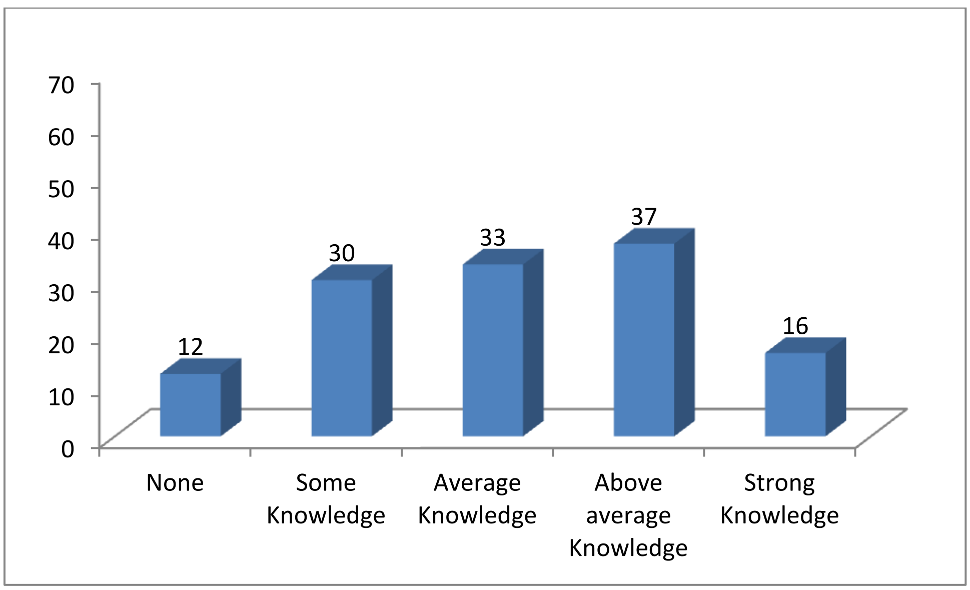

Figure 21 - Frequency of responses regarding the level of knowledge of Leadership in Energy and Environmental Design (Architects)

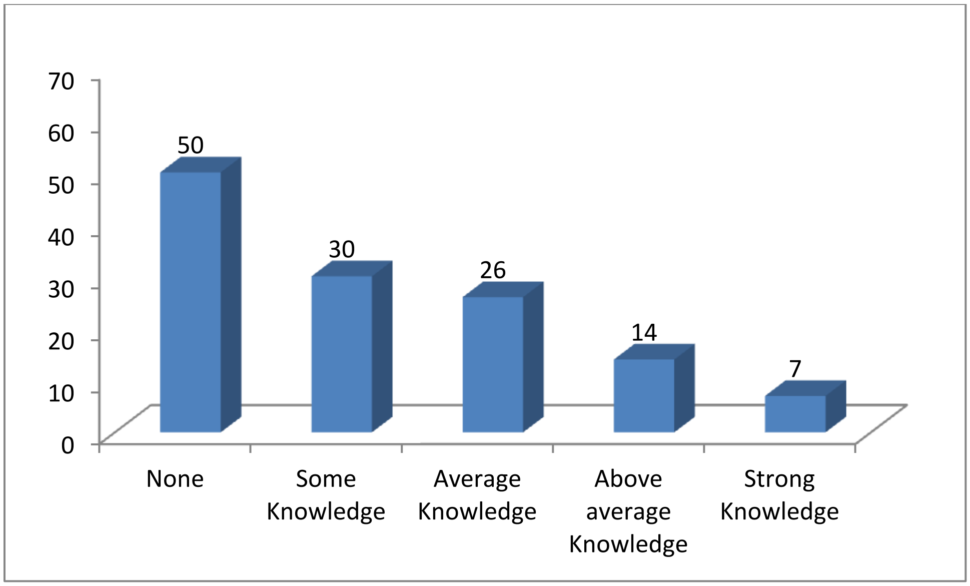

Figure 22 - Frequency of responses regarding the level of knowledge of 2012 changes to LEED (Architects)

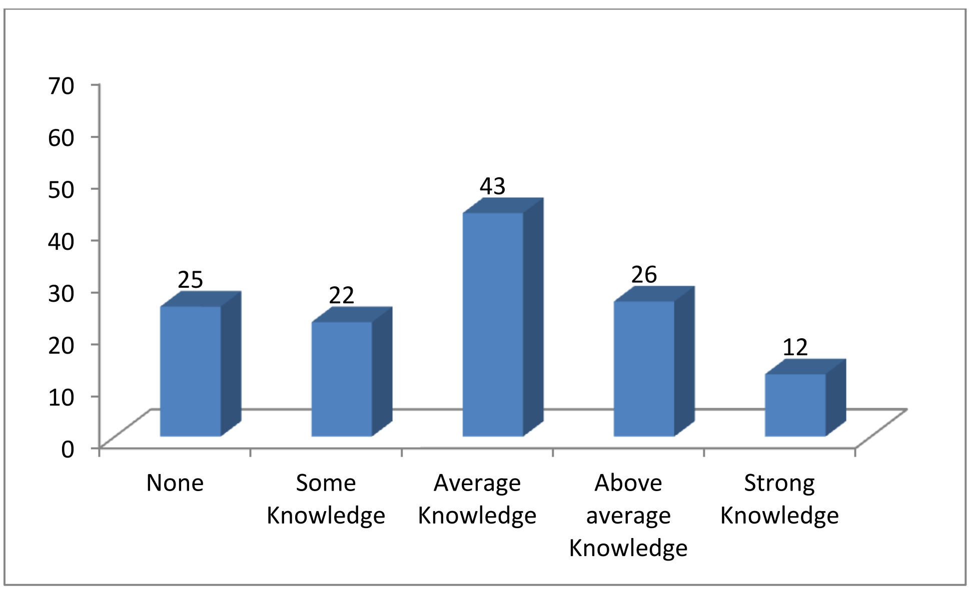

Figure 23 - Frequency of responses regarding the level of knowledge of forest certifications (Architects)

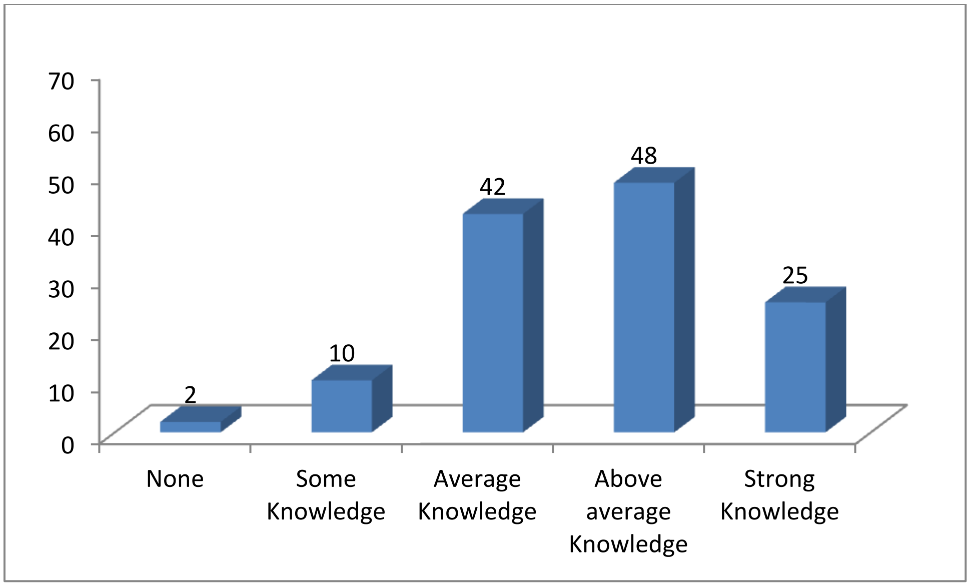

Figure 24 - Frequency of responses regarding the level of knowledge of wood species (Architects)

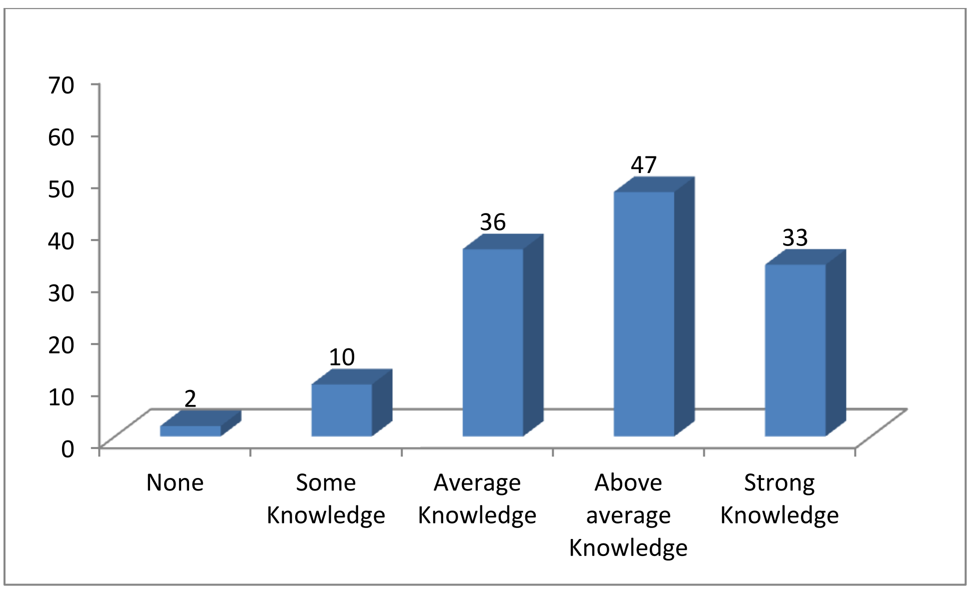

Figure 25 - Frequency of responses regarding the level of knowledge of wood strength properties (Architects)

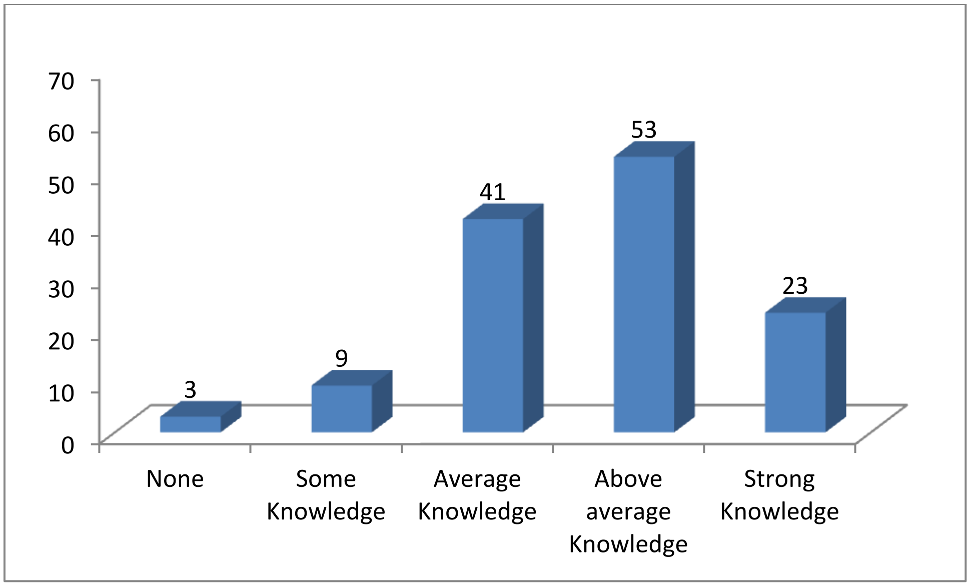

Figure 26 - Frequency of responses regarding the level of knowledge of wood durability (Architects)

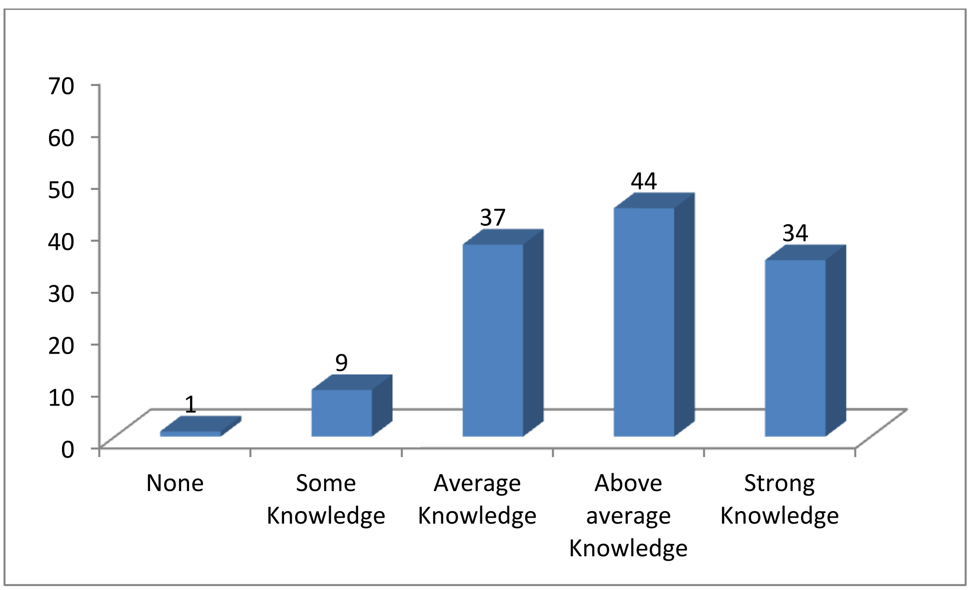

Figure 27 - Frequency of responses regarding the level of knowledge of hardwood versus softwood (Architects)

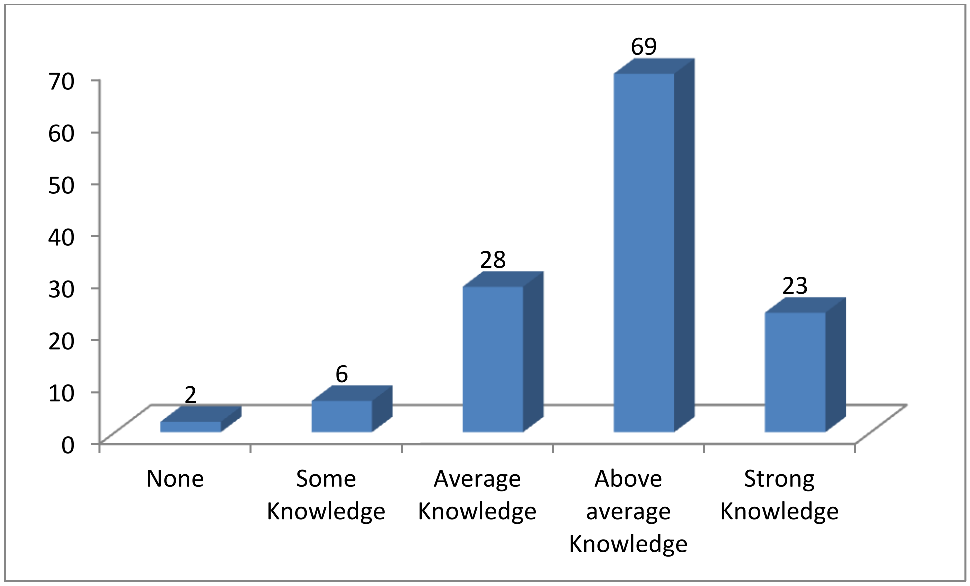

Figure 28 - Frequency of responses regarding the level of knowledge of specifying wood products (Architects)

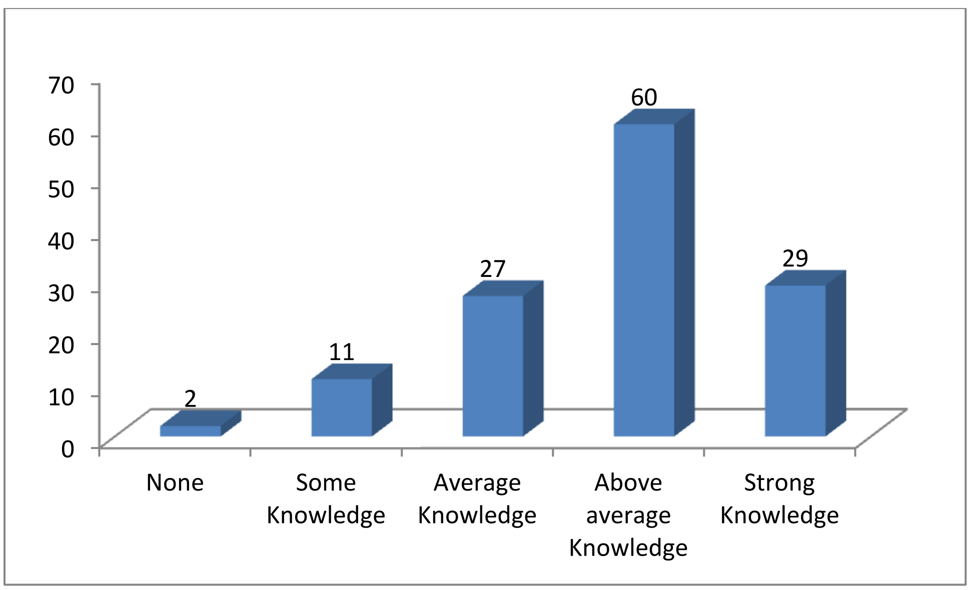

Figure 29 - Frequency of responses regarding the level of knowledge of building codes (Architects)

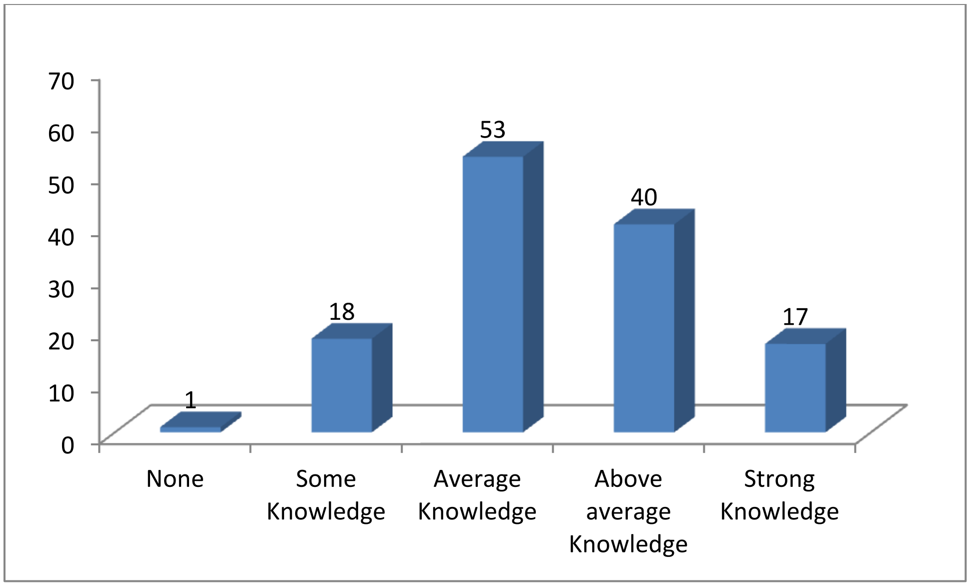

Figure 30 - Frequency of responses regarding the level of knowledge of new wood products (Architects)

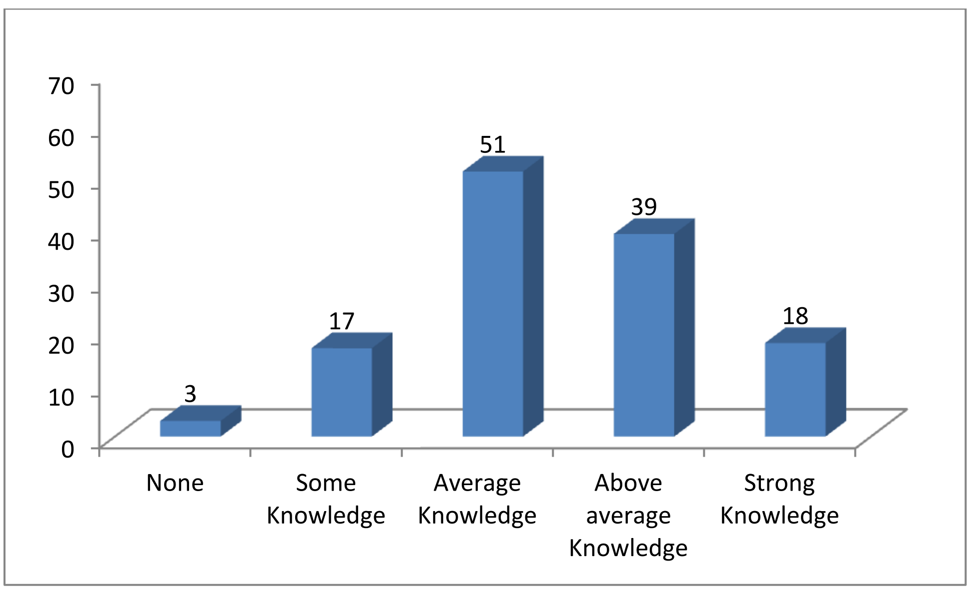

Figure 31 - Frequency of responses regarding the level of knowledge of moisture content related to wood (Architects)

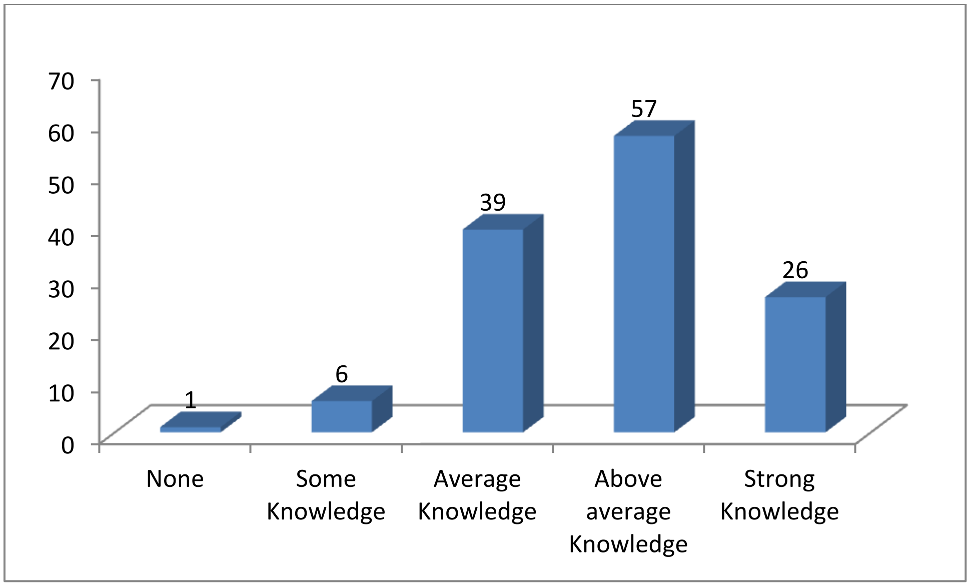

Figure 32 - Frequency of responses regarding the level of knowledge of wood composites (Architects)

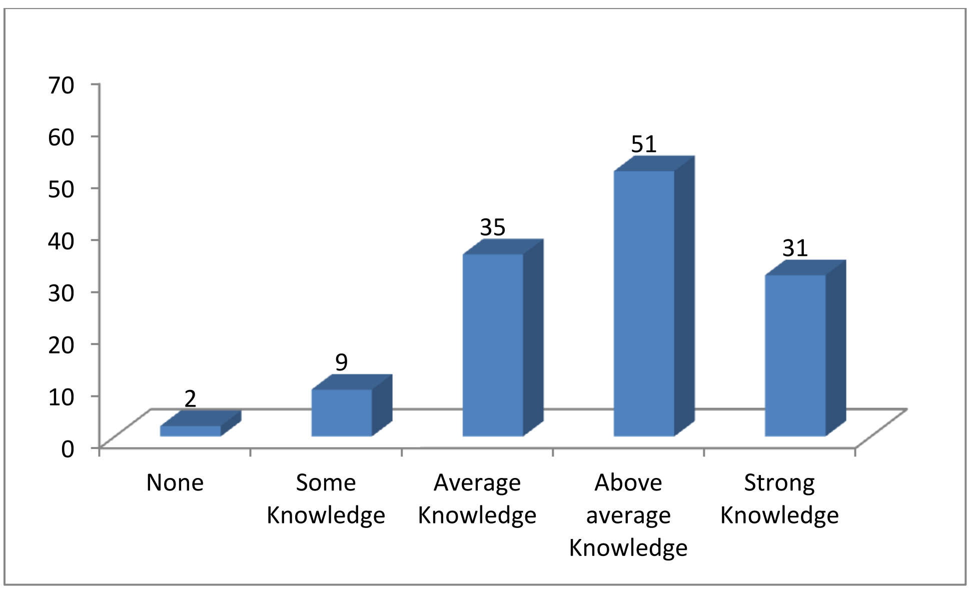

Figure 33 - Frequency of responses regarding the level of knowledge of engineered wood products (Architects)

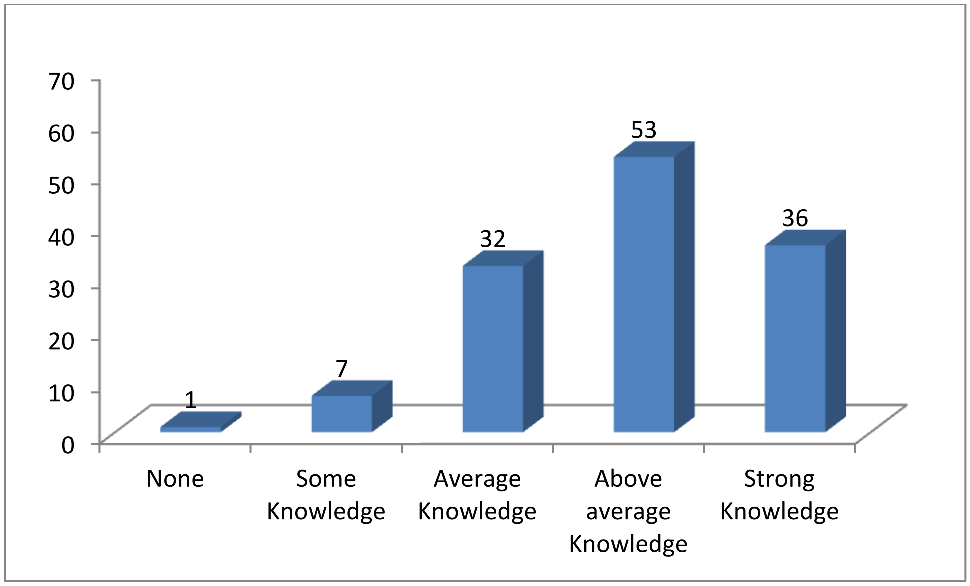

Figure 34 - Frequency of responses regarding the level of knowledge of wood connections (Architects)

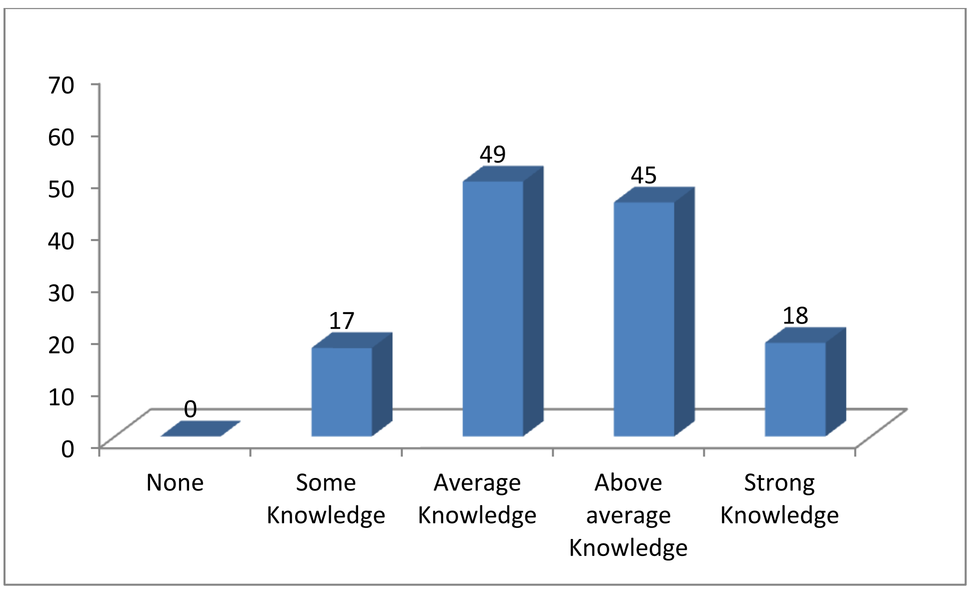

Figure 35 - Frequency of responses regarding the level of knowledge of wood finishing and coatings (Architects)

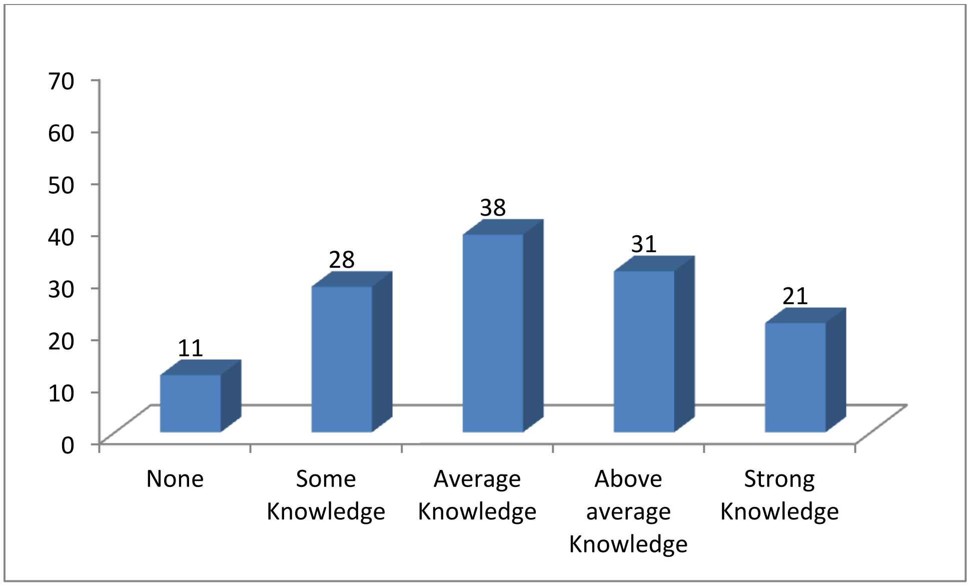

Figure 36 - Frequency of responses regarding the level of knowledge of volatile organic compounds (Architects)

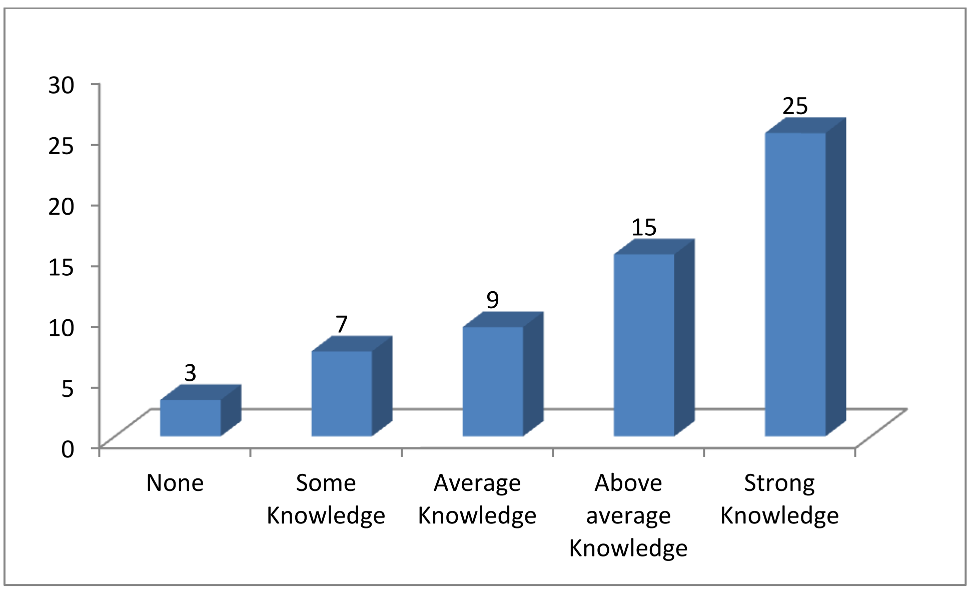

Figure 37 - Frequency of responses regarding the level of knowledge of structural wood products (Engineers)

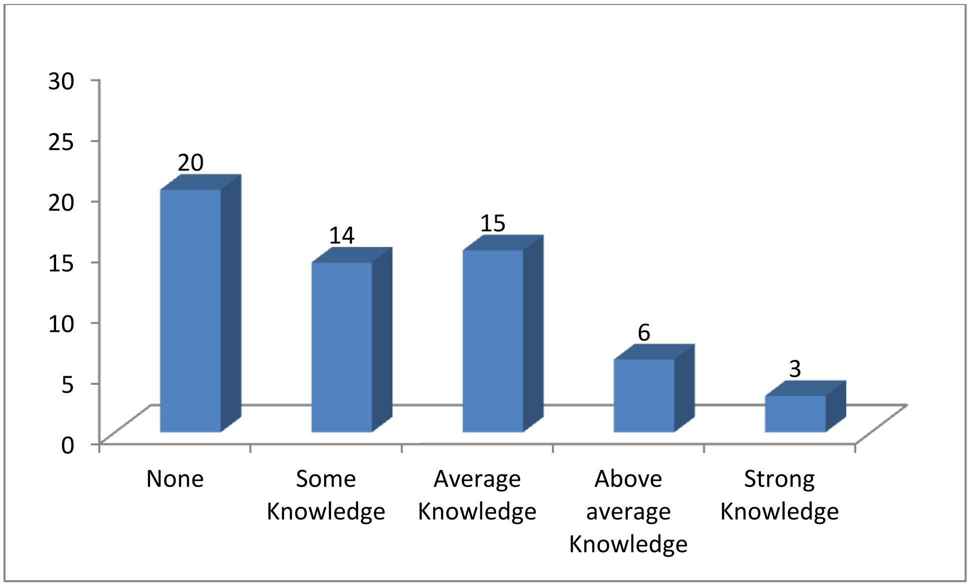

Figure 38 - Frequency of responses regarding the level of knowledge of Leadership in Energy and Environmental Design (Engineers)

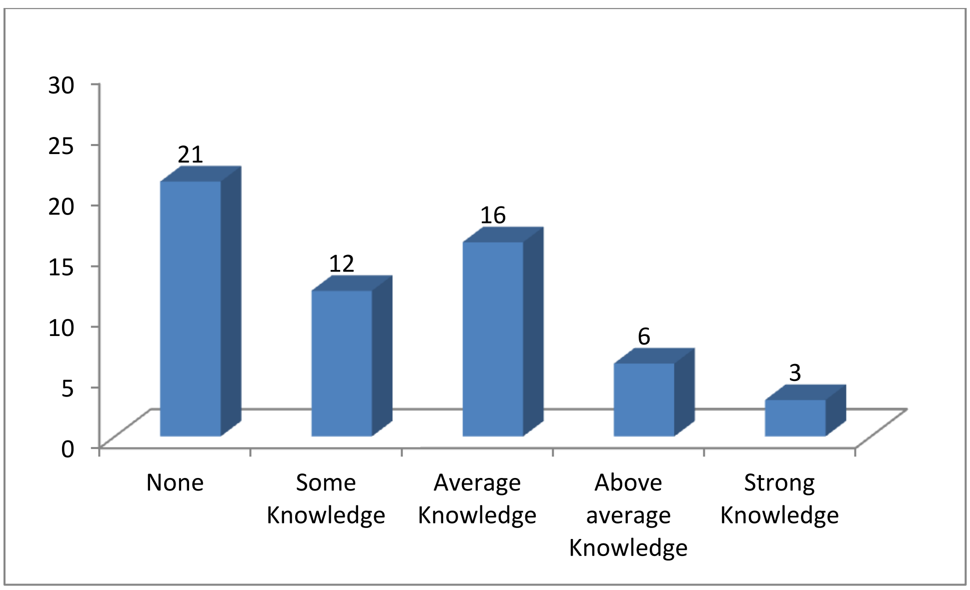

Figure 39 - Frequency of responses regarding the level of knowledge of green certifications of Wood products (Engineers)

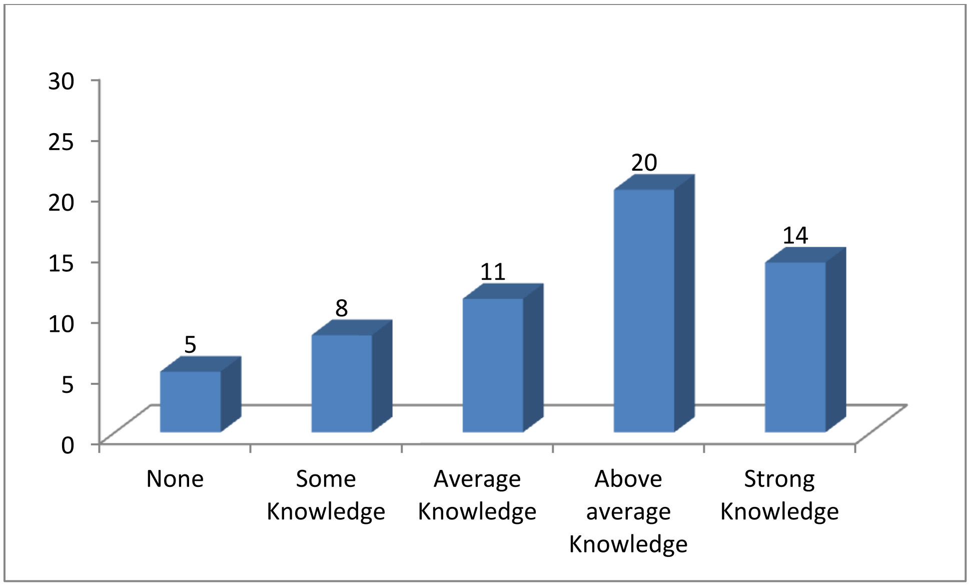

Figure 40 - Frequency of responses regarding the level of knowledge of wood species (Engineers)

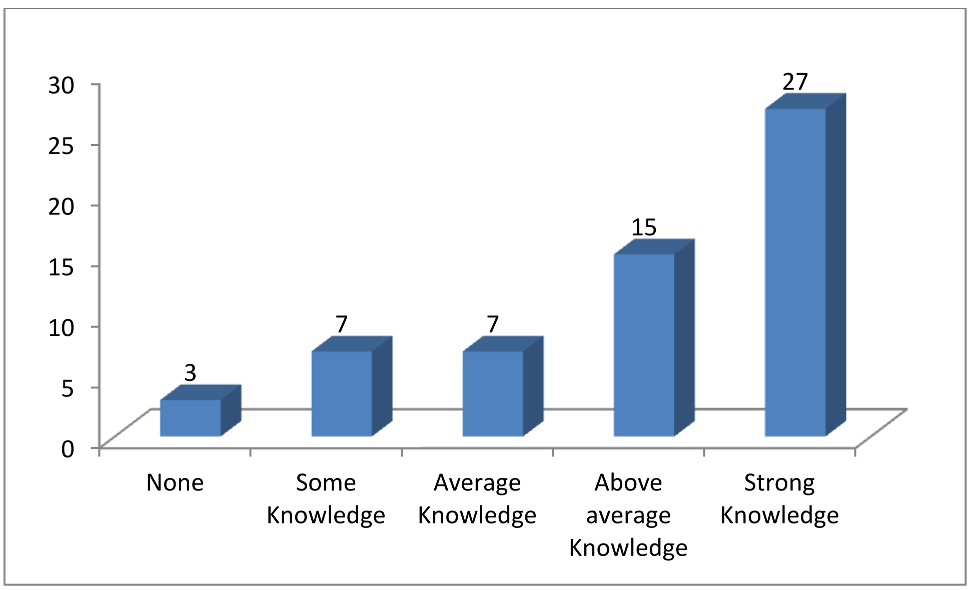

Figure 41 - Frequency of responses regarding the level of knowledge of wood strength properties (Engineers)

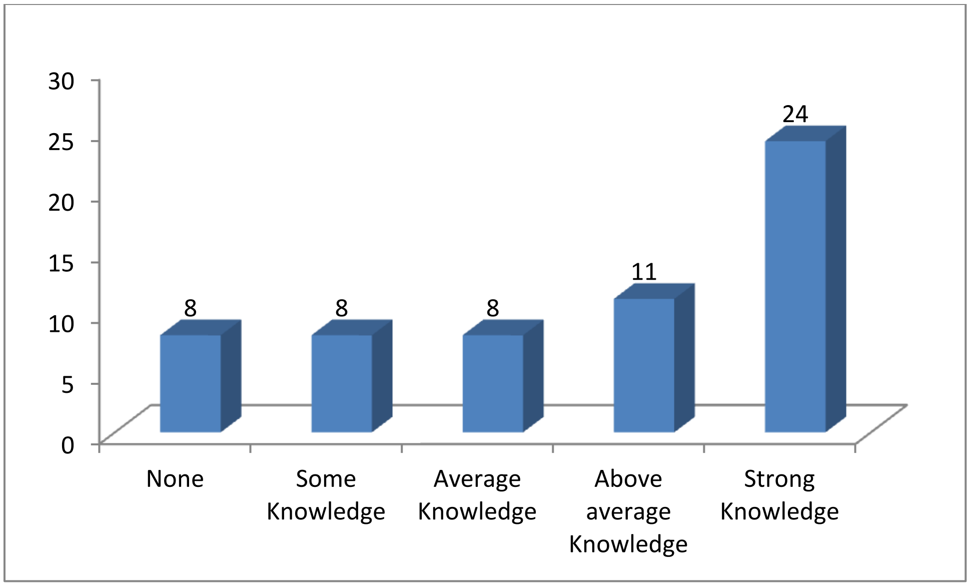

Figure 42 - Frequency of responses regarding the level of knowledge of wood connections (Engineers)

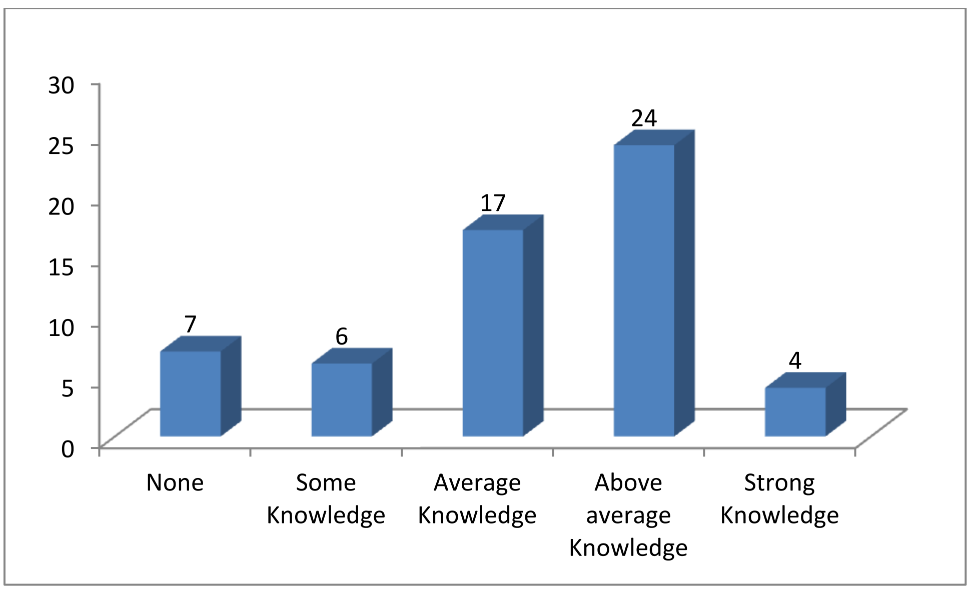

Figure 43 - Frequency of responses regarding the level of knowledge of wood durability (Engineers)

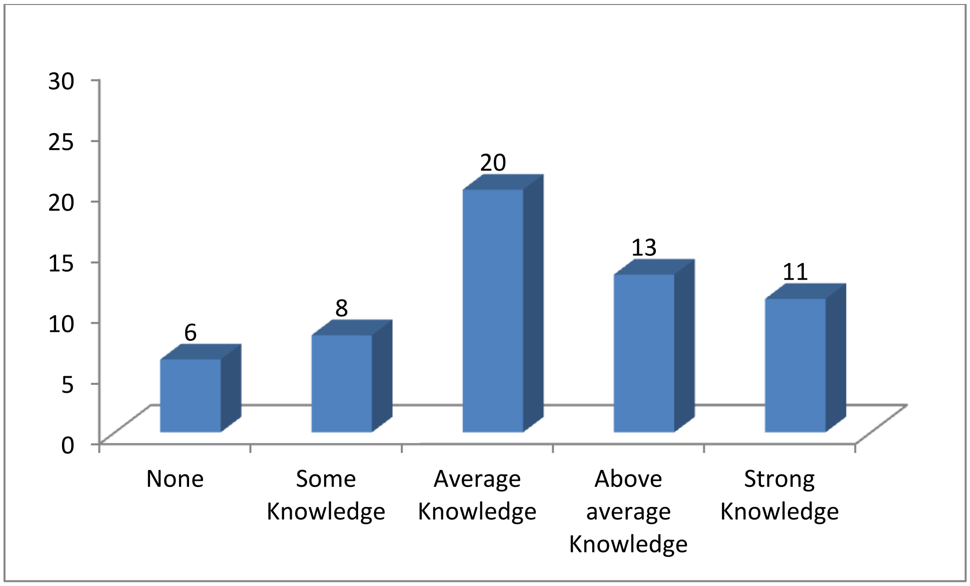

Figure 44 - Frequency of responses regarding the level of knowledge of hardwood versus softwood (Engineers)

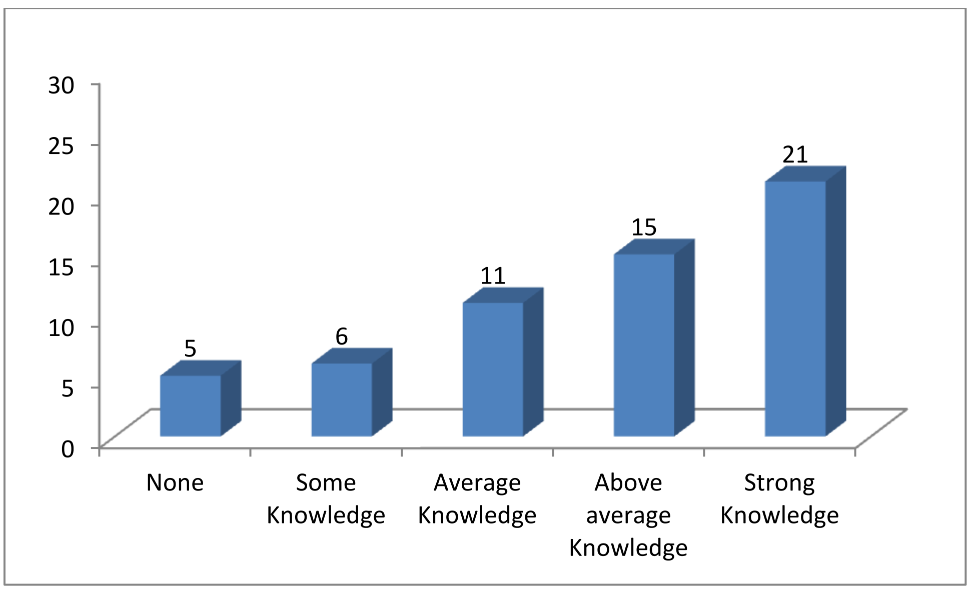

Figure 45 - Frequency of responses regarding the level of knowledge of specifying wood products (Engineers)

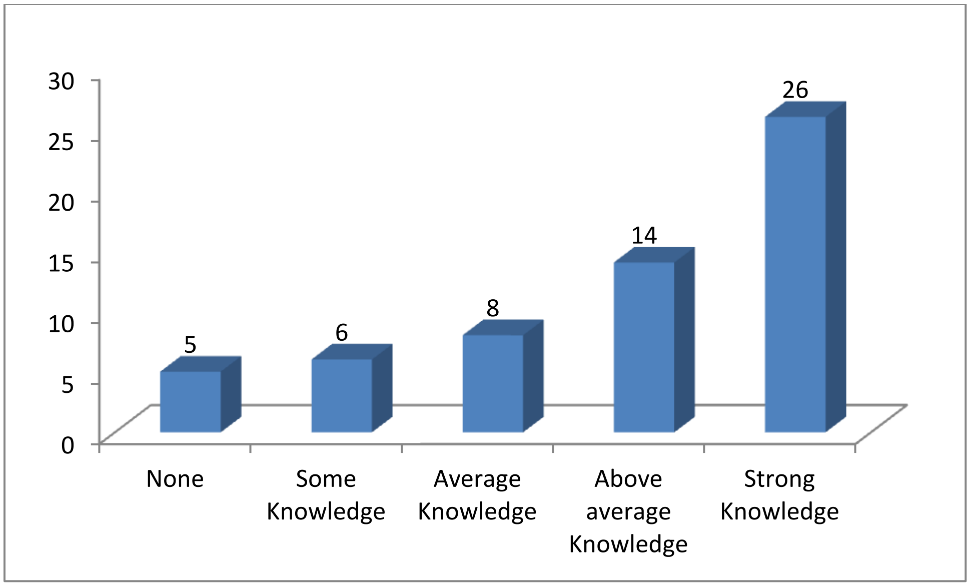

Figure 46 - Frequency of responses regarding the level of knowledge of building codes (Engineers)

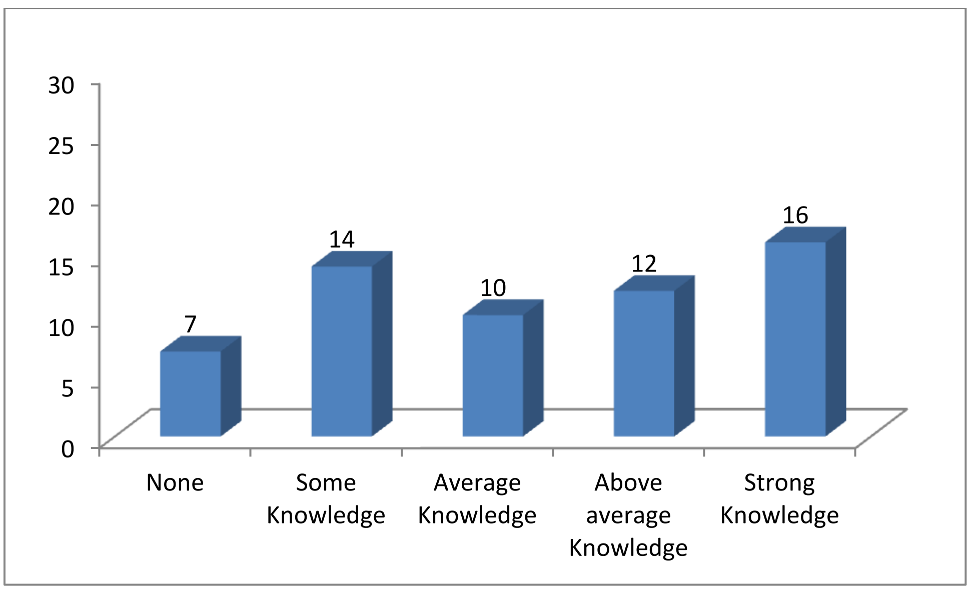

Figure 47 - Frequency of responses regarding the level of knowledge of new wood products (Engineers)

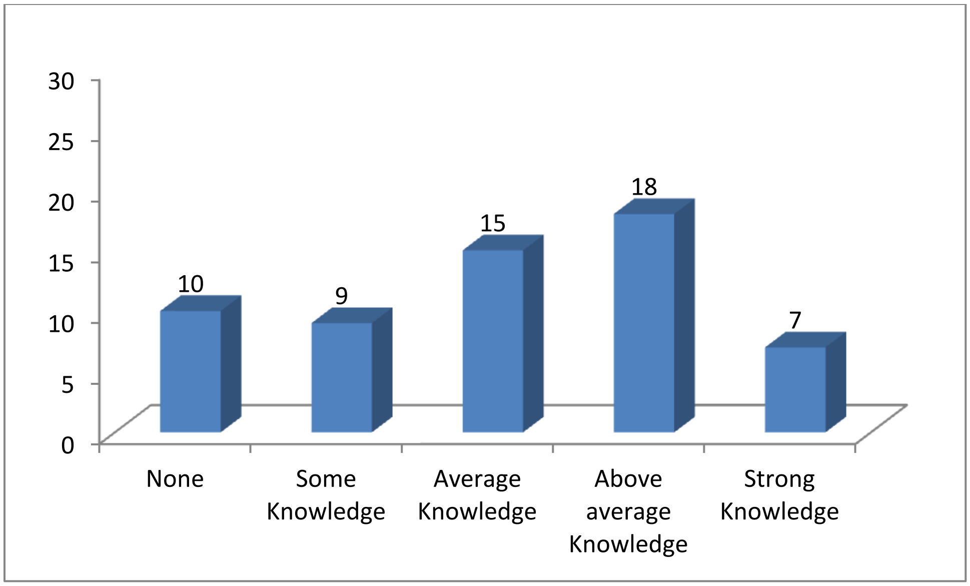

Figure 48 - Frequency of responses regarding the level of knowledge of moisture content related to wood (Engineers)

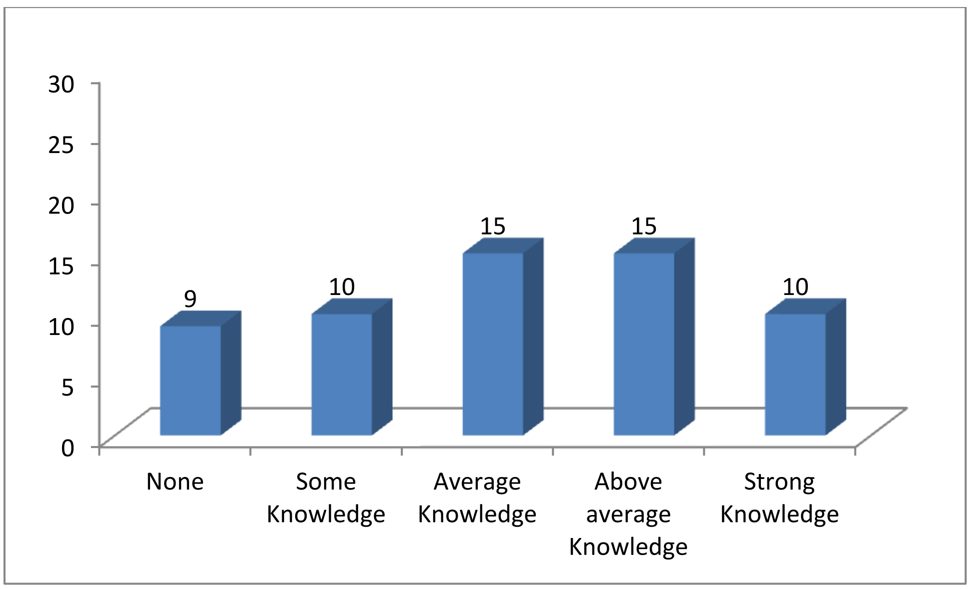

Figure 49 - Frequency of responses regarding the level of knowledge of wood composites (Engineers)

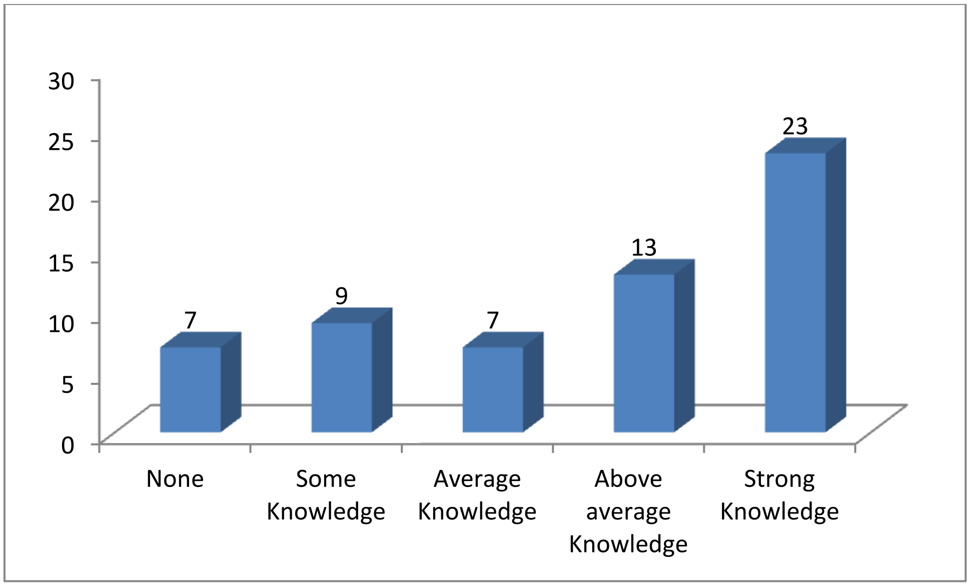

Figure 50 - Frequency of responses regarding the level of knowledge of engineered wood products (Engineers)

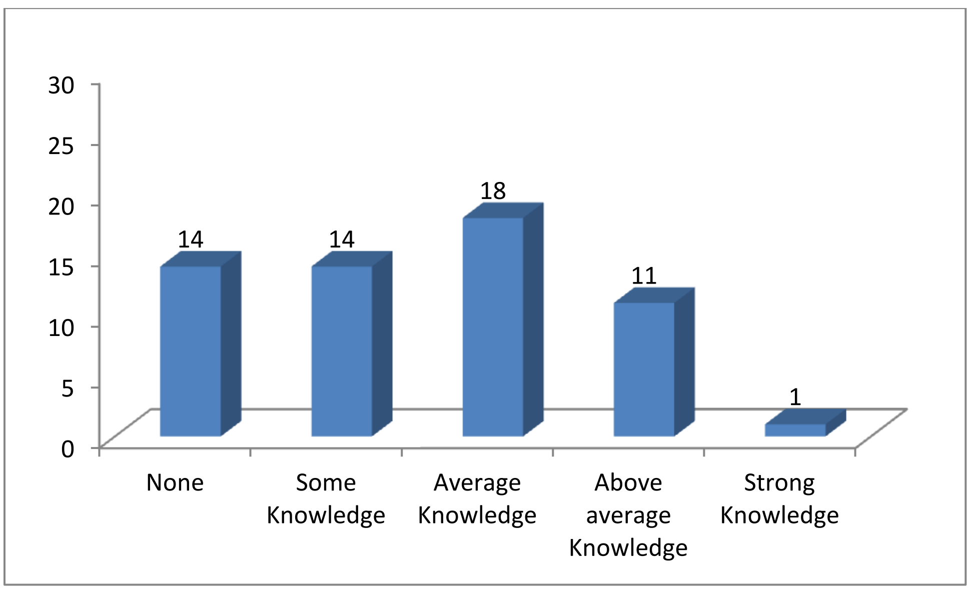

Figure 51 - Frequency of responses regarding the level of knowledge of wood finishing and coatings (Engineers)

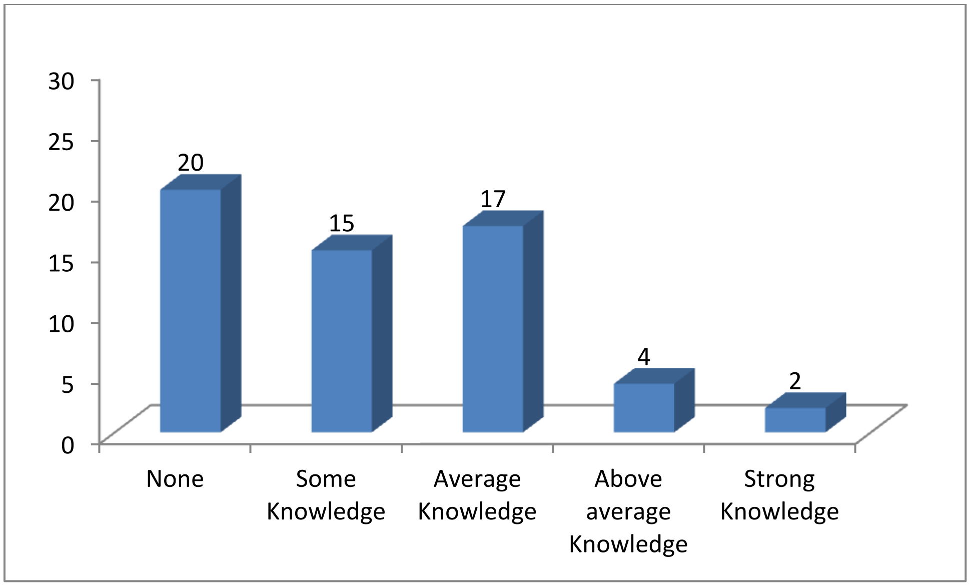

Figure 52 - Frequency of responses regarding the level of knowledge of volatile organic compounds (Engineers)

Appendix B – Questionnaires

Architect Questionnaire

Travis Roth, Graduate Student
Department of Wood Science & Engineering
Oregon State University, 119 Richardson Hall, Corvallis, Oregon 97331-5751
E-mail Travis.Roth@OregonState.edu

Dear Architect,

Purpose of this study:
This study is being conducted by Travis Roth, a graduate student of the Wood Science Department at Oregon State University in order to better understand the current knowledge level regarding wood and wood products. The questionnaire will also be looking at how wood and wood products are specified and specific problems related to specification of wood. This research is intended to help make Continuing Education about wood more useful.

Questionnaire procedures and approximate duration of the study:
There will be three sections to the questionnaire, Knowledge, CEU, and Specifying. Each section will provide direction where necessary to make completion easier. The questionnaire will focus on wood and wood products and will take approximately 15 minutes to complete.

Confidentiality assurance:
Your completion of the questionnaire indicates your consent to participate in this study. Please be assured that your responses will be held in the strictest confidence. As soon as I receive your completed questionnaire, the data will be entered into a secure computer and analyzed as a group. All data will be stored for three years in a secure location, and then destroyed. If the results of this study were to be written for publication, no identifying information will be used.

Contact information:
If you have any questions about this study, you can contact the person(s) below:

Principal Investigator	Student Researcher
Dr. Chris Knowles	Travis Roth
Oregon State University	Oregon State University
119 Richardson Hall	119 Richardson Hall
Corvallis Oregon 97333	Corvallis Oregon 97333
	Travis.Roth@oregonstate.edu

This study has been reviewed and approved by The Oregon State University Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact student researcher. If you have any questions about your rights or welfare as a participant, please contact the Oregon State University Institutional Review Board (IRB) Office at (541) 737-8008 or by email at IRB@oregonstate.edu.

Sincerely,

Travis Roth

Answer the following question by indicating the level of knowledge on a scale of 1-5 (1 - None, 5 – Strong) and the importance of that knowledge to your profession on a scale of 1-5 (1 – Not Important, 5 – Very Important).

OVERALL KNOWLEDGE OF....	Knowledge	Importance
Structural wood?	1 2 3 4 5	1 2 3 4 5
Non-Structural wood?	1 2 3 4 5	1 2 3 4 5
Green Globes?	1 2 3 4 5	1 2 3 4 5
LEED?	1 2 3 4 5	1 2 3 4 5
Changes happening in LEED, 2012?	1 2 3 4 5	1 2 3 4 5
Forest Certification?	1 2 3 4 5	1 2 3 4 5
Wood Species?	1 2 3 4 5	1 2 3 4 5
Wood strength and properties?	1 2 3 4 5	1 2 3 4 5
Wood Durability (Biological/ Environmental)?	1 2 3 4 5	1 2 3 4 5
Hardwood vs. Softwood?	1 2 3 4 5	1 2 3 4 5
Specifying wood and wood products?	1 2 3 4 5	1 2 3 4 5
Wood building codes?	1 2 3 4 5	1 2 3 4 5
New wood and wood composite products?	1 2 3 4 5	1 2 3 4 5
Moisture content control in wood?	1 2 3 4 5	1 2 3 4 5
Composite Products? Particle Board, Plywood	1 2 3 4 5	1 2 3 4 5
Engineered wood composites? Glulam	1 2 3 4 5	1 2 3 4 5
Wood connections?	1 2 3 4 5	1 2 3 4 5
Wood Design?	1 2 3 4 5	1 2 3 4 5
Wood finishing/ Coating	1 2 3 4 5	1 2 3 4 5
Volatile Organic Compounds?	1 2 3 4 5	1 2 3 4 5

Continuing Education

On average how many continuing education credits do you receive each year?

1-5 6-10 11-15 16-20 21-25 26-30 31 or more

How many are required by licensing stipulations?

____

Of the credits you obtained in the past 3 years, how many focused on wood?

1-2 3-4 5-6 7-8 9 or more Don't Know

How do you accomplish your credits?

Online Seminars College Courses Lunch and Learns

Annual meetings (i.e AIA) Other__________

Which of the following tools do you use to search for credits?

Internet Searches Professional Organization Newsletters Magazines Colleagues

Other______________________________________

Are you a member of a Professional Organization? YES NO
If so which one?

____

If, you are a member of AIA do you only rely on AIA to get CEU credits?

____

Have you received formal training about wood products that you have incorporated into your building designs?

____

Specifying wood

What characteristics of wood matter when specifying for structural use?

Durability Strength Size Appearance Species

Cost Availability

What characteristics of wood matters when specifying for non-structural use?

Durability Strength Size Appearance Species

Cost Availability

On a Scale 1-5 (1 Does not Impact, 5 Strong Impact)
Do environmental impacts matter in specifying?
1 2 3 4 5

Does Forest Certification impact specifying?
1 2 3 4 5

Has added Formaldehyde played a role in specifying?
1 2 3 4 5

On a Scale 1-5 (1 Not Important, 5 Very Important)
How important are environmental impacts in specifying?
1 2 3 4 5

How important is Forest Certification on specifying?

1 2 3 4 5

How concerned about added Formaldehyde are you when specifying?

1 2 3 4 5

What kind of building projects do you most often work on?

Residential Commercial Industrial

What are the main products that you work with, when specifying Structural wood?

Glulam Lumber LVL Plywood OSB iJoists Timber other______

When Specifying Non-structural wood?

Moulding cabinets flooring ceilings Millwork Plywood

Other________

What are your biggest challenges to specifying wood?

Code Cost Durability Size Strength Appearance Species

What wood products do you specify most often?

____

Demographics

State Licensed in?

Oregon Washington California Idaho Nevada Colorado Other______

How long have you been a practicing architect/engineer?

1-5 6-10 11-15 16-20 21-25 26 or more

Engineer Questionnaire

OSU Oregon State University
Travis Roth, Graduate Student
Department of Wood Science & Engineering
Oregon State University, 119 Richardson Hall, Corvallis, Oregon 97331-5751
E-mail Travis.Roth@OregonState.edu

Dear Engineer,

Purpose of this study:
This study is being conducted by Travis Roth, a graduate student of the Wood Science Department at Oregon State University in order to better understand the current knowledge level regarding wood and wood products. The questionnaire will also be looking at how wood and wood products are specified and specific problems related to specification of wood. This research is intended to help make Continuing Education about wood more useful.

Questionnaire procedures and approximate duration of the study:
There will be three sections to the questionnaire, Knowledge, CEU, and Specifying. Each section will provide direction where necessary to make completion easier. The questionnaire will focus on wood and wood products and will take approximately 15 minutes to complete.

Confidentiality assurance:
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Principal Investigator	Student Researcher
Dr. Chris Knowles	Travis Roth
Oregon State University	Oregon State University
119 Richardson Hall	119 Richardson Hall
Corvallis Oregon 97333	Corvallis Oregon 97333
	Travis.Roth@oregonstate.edu

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Sincerely,

Travis Roth

Answer the following question by indicating the level of knowledge on a scale of 1-5 (1 - None, 5 – Strong) and the importance of that knowledge to your profession on a scale of 1-5 (1 – Not Important, 5 – Very Important).

OVERALL KNOWLEDGE OF….	Knowledge	Importance
Structural wood?	1 2 3 4 5	1 2 3 4 5
LEED?	1 2 3 4 5	1 2 3 4 5
Green Certification?	1 2 3 4 5	1 2 3 4 5
Wood Species?	1 2 3 4 5	1 2 3 4 5
Wood strength and properties?	1 2 3 4 5	1 2 3 4 5
Designing with wood?	1 2 3 4 5	1 2 3 4 5
Connectivity issues with wood?	1 2 3 4 5	1 2 3 4 5
Wood Durability (Biological or Environmental)?	1 2 3 4 5	1 2 3 4 5
Hardwood vs. Softwood?	1 2 3 4 5	1 2 3 4 5
Specifying wood and wood products?	1 2 3 4 5	1 2 3 4 5
Wood building codes?	1 2 3 4 5	1 2 3 4 5
New wood and wood composite products?	1 2 3 4 5	1 2 3 4 5
Moisture content control in wood?	1 2 3 4 5	1 2 3 4 5
Composite Products? Ex) Particle Board	1 2 3 4 5	1 2 3 4 5
Engineered wood composites? Ex) Plywood	1 2 3 4 5	1 2 3 4 5
Wood finishing/ Coating	1 2 3 4 5	1 2 3 4 5
Volatile Organic Compounds?	1 2 3 4 5	1 2 3 4 5

Continuing Education

On average how many continuing education credits do you receive each year?

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Are you a member of a Professional Organization? YES NO

If so which one?

____

Have you received formal training about wood products that you have incorporated into your building designs?

____

Specifying wood

What characteristics of wood matter when specifying for structural use?

Durability Strength Size Appearance Species

Cost Availability

What characteristics of wood matters when specifying for non-structural use?

Durability Strength Size Appearance Species

Cost Availability

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Does Forest Certification impact specifying?
1 2 3 4 5

Has added Formaldehyde played a role in specifying?
1 2 3 4 5

On a Scale 1-5 (1 Not Important, 5 Very Important)
How important are environmental impacts in specifying?
1 2 3 4 5

How important is Forest Certification on specifying?
1 2 3 4 5

How concerned about added Formaldehyde are you when specifying?
1 2 3 4 5

What are the main products that you work with, when specifying Structural wood?

Glulam Lumber LVL Plywood OSB iJoists Timber other______

When Specifying Non-structural wood?

Moulding cabinets flooring ceilings Millwork Plywood Other________

What are your biggest challenges to specifying wood?

Code Cost Durability Size Strength Appearance Species

What wood products do you specify most often?

____

Demographics

State Licensed in?

Oregon Washington California Idaho Nevada Colorado Other______

How long have you been a practicing architect/engineer?

1-5 6-10 11-15 16-20 21-25 26 or more

What kind of building projects do you most often work on?

Residential Commercial Industrial