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Market Opportunity Analysis: What Market Factors Influence and Determine Hemp-lime composites becoming a mainstream building product

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Abstract

The impact of buildings on the environment is enormous. Buildings consume 40% of natural resources, use 70% of all electricity produced and their waste contributes 50% to all landfills. This situation has led to governments developing policies and regulations to mitigate the serious impacts on the planet. The emerging green building market is becoming part of the construction industry. Rapid demand for products presents significant opportunities for products that can meet sustainability goals of building projects. The industry has low barriers to entry but the barriers to adoption and diffusion of new and innovative green building products are high. This is further compounded by the industries fragmented nature and its resistance to change. The research provides a comprehensive understanding of market conditions and clearly identifies factors that drive the market and those that influence adoption and products. Research uncovered a specific set of factors that influence the development of strategies to commercialize new products in the market. Thorough analysis and understanding of these factors can be used to guide the development and advancement of hemp-lime composite products paving the way for broader adoption as a mainstream building material in the construction industry.

Keywords

Sustainability, Green building products, Market opportunity, Product adoption, Hemp-lime composite

1. Introduction

1.1 Background

There is a proliferation of building products that are made from hemp-lime composites. Many are still in the development phases and face the long path to commercialization. While others already in the market are factory made or made in-situ together with a fit for purpose construction system. The composites comprise of a renewable raw material, such as hemp hurd, and lime binders to form a carbon negative, highly insulated, breathable, fire, mold, and termite resistant building. Never use letter spacing and never use more than one space after each other.

Many organizations are planning to capitalize on positive market trends in existing and emerging target markets. Accelerated growth in construction industry sectors and the rapid emergence of the green building market presents opportunities for sustainable building material like hemp-lime composites.

In 2016 the world green building market was forecast to double from 17% to 38% (Dodge Data 2016). While the Australia construction market was expected to grow by 8.1% over 5 years from 2016 to 2021 and residential construction by 14.5% (MarketLine 2017). However, the Australia residential construction market has seen a decrease from a peak in March 2021 of 14,000 building approvals to 8,000 in July 2023 (Australian Bureau of Statistics 2023). In the US building permits have decreased by 10% since 2021 (United States Census Bureau 2022). Despite these trends the green building market continues to grow.

The value of green building materials market in 2021 was US\$200b and is forecast to grow to a value of US\$750b by 2030 (More 2023). This growth trajectory signifies a growing emphasis on sustainable and eco-conscious practices within the construction industry driven by increasing awareness of environmental concerns, consumer preference for eco-friendly materials, the industry's role in promoting sustainability and energy efficiency in construction and governmental initiatives and regulations.

In the year 2021, the Residential segment emerged as the dominant contributor to the Green Building Materials market's revenue (More 2023).

In order to determine the type and level of opportunity and challenges that exist in target markets with respect to various offerings the acquisition and analysis of comprehensive market and research data is an essential task to be undertaken. This will guide the development of a

compelling business case to help secure a share of the residential construction industry for these types of products.

2. Research Topic

2.1 Market opportunity analysis

The purpose of the research is to undertake an opportunity analysis in target markets with respect to the hemp-lime composites and to make recommendations that aim to strengthen a business case that supports market entry and positioning being based on a strategic vision of hemp-lime composites becoming a mainstream building product.

The following theories (concepts or frameworks) that relate to this topic are Marketing theories including Porter's five forces, Jobs-to-be-done; and diffusion of innovation theory.

2.2 Research method

The method of the analysis is to assess the target markets and identify opportunities and threats, using a SWOT analysis, within the target markets that are related to the hemp-lime composites.

Secondary data was collected from industry reports and research papers that have surveyed the whole green building market and individual segments both globally and in Australia. Some of the sources include EBSCO Host, IBIS World and Market Line.

The data was used to identify market sizes and forecasts, competitors, their pricing and positioning and existing customer needs and potential objections.

The approach of the analysis was to analyse the target markets to assess industry attractiveness, product opportunities and market challenges.

Quantitative data analysis quantified market attributes and issues. While quantitative data analysis was used to identify, categorise and quantify the issues identified.

2.3 Literature review

Successful product commercialisation requires a relationship with a funder (Hall 1998) and the industry segment's key influencer. In the residential construction industry this is the builder (McCoy et al 2015). Hemp-lime composite product suppliers are seeking to develop a strong business case to enable these products to be adopted for use in the residential construction industry. In the achievement of this and as part of the opportunity analysis, a thorough understanding of current target

market conditions and trends, identifying the core elements of a matching customer value proposition for the builder, and establishing guiding criteria for mainstream adoption and diffusion is essential.

The literature review has revealed that there is a comprehensive understanding of factors that influence the take up of sustainable building products within the construction industry. However, while many factors have been identified little research appears to have been done on developing a complete package that can be used to guide the development of strategies to support sustainable building products to become mainstream.

Therefore, the research approach sort to establish a comprehensive understanding of the target market and the forces at play including their strategic implications. Firstly, using Porter's framework of competitive forces (Porter 1979) and a SWOT analysis. Secondly, to identify core elements of the customer value proposition with respect to the targeted segments using Christensen's 'job to be done' framework (Christensen 2016 & 2007) and thirdly, applying Roger's diffusion adoption theory (Rogers 1976) to develop guiding criteria for the commercialization of the hemp-lime composite products into the mainstream market.

A review of research literature specifically related to the construction industry with respect to the aforementioned frameworks and theories has been completed. This included research that was undertaken regarding industry attractiveness, understanding the customer value proposition to identify market segments and the adoption and diffusion of innovative building products in the construction industry.

2.4 Industry attractiveness – assessing target markets

The construction industry is price and time sensitive as these factors can have substantial impacts on the success of building projects (Stoy & Schalcher 2007). Pressure is mounting on construction businesses to change their practices as a result of compliance with regulations and to meet growing consumer demand for sustainable buildings while at the same time attempting to maintain slim profit margins (Giesekama et al 2014). Industry profit margins, in Australia, are on average 7.7% (IBISWorld 2023). In an effort to tackle these issues there is a trend toward lean construction practices and using sustainable building materials to increase profitability and reduce the environmental impact of buildings (Forbes 2015). These conditions appear to indicate suitable market opportunities exist for green building products, like hemp-lime composite products, to gain mainstream market appeal and use. However, an industry attractiveness analysis is required to ascertain the level and type of opportunities and associated challenges.

Prior to commercialising a product, it is necessary to understand the nature and dynamics of the intended industry and influencing factors to assess industry attractiveness (Ozorhon & Oral 2017). Porter's five forces (Porter 1979) can be used to identify the degree of difficulty or ease of market entry, the level and type of competition and the power of various players.

The construction industry in Australia is highly fragmented with low barriers to market entry (Marketline 2016, IBISWorld 2023). It comprises of many small players that operate on a project-by-project basis (Giesekama et al 2015).

Any producer of hemp-lime composites needs to give serious consideration to identifying the potential challenges of getting product adoption and diffusion in a fragmented industry populated by many small businesses resistant to change.

2.5 Understanding the customer value proposition to identify market segments

The ability to identify segments within a market based on customer characteristics is widely viewed as a core component of marketing. Segmentation analysis can be achieved using different concepts and theories (Oestreicher 2011).

Christensen's 'jobs-to-be-done' theory focuses on segmenting markets based on the jobs a product or service can do for a customer. As he has pointed out the 'job-to-be-done' may not be immediately obvious, as it may not be directly related to the product. Sometimes significant research and analysis needs to be undertaken to correctly identify segments. Once the characteristics of the segment have been understood it is then possible to develop a matching customer value proposition that get the customer's job done (Christensen 2016).

Markets can be segmented on this basis rather than the traditional approach to market segmentation based simply on demographics or a product-focused approach (Ulwick 2002).

Adoption and diffusion of innovative building products

The stated focus of the hemp-lime composites was to position organizations providing products to, initially, enter the market through the segment of innovative builders then move onto early adopters and eventually to the mainstream market segment.

An understanding of market specific segments is necessary as product qualities and knowledge requirements vary across construction industry segments (Sanderford et al 2015).

There appears to be two schools of thought regarding the adoption and diffusion of innovation within the construction industry. One is that builders are slow to take up innovations owing to the difficulty of changing practices to easily enable the adoption of new building products (Koskela and Vrijhoef 2001), (Häkkinen & Belloni 2011) and (Ilter et al 2011). The other suggests that the construction sector has seen rates of adoption of innovation similar to that of other industries (Slaughter 1993). This view has been based on substantial changes to the way buildings were constructed then compared to the previous 40 years.

Within these opposing viewpoints exist a vast body of literature highlighting that innovation is key to building a competitive advantage in the industry. However, adoption and diffusion of the innovation face many challenges (Sexton and Barrett 2003). Therefore, it is reasonable to assume emphasis should be placed on understanding different market segments to develop criteria for strategies that guide successful adoption and rapid diffusion of any hemp-lime composite innovation to gain and maintain competitive advantage (Slaughter 2000).

For example, Builders have indicated that they normally adopt a new product if it has a comparable price point, is proven and compliant and easily integrated into existing construction practices (Teo and Runeson 2001).

The approach of the research was to collect, review and analyse quantitative and qualitative secondary data to enable articulation of market conditions and the forces at play that define industry attractiveness, identify market segments to assist hemp-lime composite product producers to formulate a matching customer value proposition and importantly, to develop criteria to guide the development of adoption and diffusion strategies for their products to become a mainstream building product.

3. Methodology

3.1 Research methodology

Case study research was deemed as the most applicable method to understand events concerning the rapid emergence of the green building industry and the challenges and opportunities the organisation may have in order for its product to become a mainstream building material.

The collection and analysis of secondary data from relevant empirical research papers together with industry reports form an important part of the methodology. This approach aimed to discover and define patterns to develop, test and compare theoretical propositions that provide the base logic on which to answer the fundamental topics of inquiry concerning the research question (Gog 2015).

Fundamental to answering the research question are four areas of inquiry: (1) are current and projected market conditions favourable for the product becoming mainstream; (2) what the common barriers to market adoption are; (3) what product characteristics are likely to address market segment's needs; and (4) to discover criteria to guide the development of product adoption and diffusion strategies.

3.2 Data collection

Qualitative and quantitative secondary data concerning the construction industry relevant to the research were collected and analysed from 76 research papers and industry reports from around the globe. Over 72% of the research papers were peer reviewed. Quantitative data collected from reliable industry report sources included Market Line, the World Green Building Council (Dodge 2016), Turner Construction and (Turner 2014) McGraw Hill Construction (McGraw 2014) and IBISWorld.

The strategic focus of the qualitative secondary data analysis process entailed utilising the following types of coding: opening coding, axial coding and selective coding. This type of approach is based on grounded theory where the researcher reviews literature without having predetermined theories concerning expected findings (Glaser 1978). The initial review process results in the conceptualization of recurrent patterns from the data. Using the aforesaid codification techniques emergent patterns with similar characteristics can be defined and eventually grouped into a category.

These categories may then be further evaluated to discover a main group of which they become sub-categories (Xiaofeng et al 2013). The process ceased when theoretical capacity was achieved after continuous review and analysis of the data did not reveal any new patterns and further categorisation was deemed unnecessary (Bowen 2008).

The codified qualitative data was then analysed to assess the strength of the individual market drivers, the level of each individual barrier and identified product attributes and factors purported to aid in successful product adoption and diffusion. The frequency of each sub-category contained within the main category was then calculated and graphed. Observations were then made to deduce if any of the categories were

interrelated as a result of the influence of others. Quantitative data obtained from industry reports was utilised to assess industry attractiveness (Porter 2008) to the case organisation.

It is critical for any organisation to understand the environment in which it intends to operate, including competitive forces within the market and the associated attributes of the organisation itself. This knowledge supports the development of strategies that act to guide a business to develop and sustain competitiveness in its target markets (Porter 2008). One approach in achievement of this is to undertake an analysis of the internal strengths and weakness of the organisation together with an external analysis of market threats and opportunities, commonly referred to as a SWOT analysis (Siciliano 2016). External influences on a firm can be assessed using Porters 5 forces framework (Porter 2008).

4. Presentation Of Findings

4.1 Data analysis

The analysis found there is strong growth in the emerging green building market. There is a demand for new and innovative products that are able to satisfy market requirements. While market growth, demand and drivers highlight an attractive industry many influential challenges are identified that affect successful commercialization and sustained competitive advantage. These factors include barriers to mainstream adoption and diffusion of sustainable building products, required product attributes to satisfy the market and key market players that influence the selection of green building materials during building development and construction project phases. The market was shown to be price and practice sensitive, highly fragmented, and resistant to change.

A SWOT analysis was undertaken using Porter's market forces framework to identify factors that influence the market environment. Industry reports and research papers were reviewed to determine market conditions including the types of threats that producers are likely to face and the opportunities it may have for market entry to maintain and sustain a competitive advantage enabling its product to become mainstream building material in the construction industry.

Table 1 shows the results of a SWOT analysis for a provider of hemp-lime composite products. In summary, many organizations were assessed to have technical expertise and product strengths. However, it highlighted serious weaknesses with respect to being market ready. Mainstream adoption and diffusion of the product are affected by the identified threats that underscore the challenges and opportunities in a market that is highly fragmented market while experiencing fluctuating growth and increasing demand for green building materials with customers resistant to change.

Table 1. Internal influences – Case organization

Strengths	Weaknesses
Technical building skills	Lack of development funding
Requisite business skills	Unproven product
Experience in the market	Product not certified
Innovative green product	No engineering expertise
Superior building materials	Product unknown to the market
Simple, fast & easy to erect	Target market knowledge incomplete
Threats	Opportunities
Market lacks product knowledge	Shortage of housing increases prices
Many substitute products exist	High demand for green building materials
Perceived high cost of 'Green' products	Consumers are becoming more educated
Highly fragmented market with many players	Low Barriers to market entry
Continuous availability of raw materials	Market has multiple points of entry
Volume builders have buying power	Renewable compliant products are sought
Customers resistant to change	Market segments seek to increase margins
New Technologies (eg: 3D Printing)	Markets are price sensitive

An extensive review of 76 relevant research papers and industry reports concerning the construction industry was compiled.

A specific detail of literature reviewed is outlined in appendix 2. Almost 70% of the literature reviewed was peer reviewed. While 74% originated in developed countries including USA, Canada, Europe, UK, Australia, and New Zealand (Fig. 1).

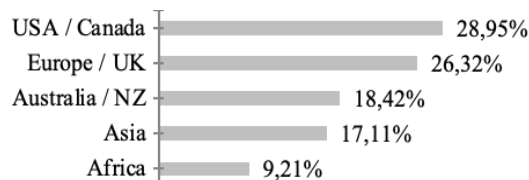


Fig. 1 Research Countries of Origin

This may suggest that developed countries could be further advanced with green building innovation and integration than undeveloped countries.

Universities published approximately 90% (Fig. 2) of the literature between 2008 and 2017 (Fig. 3) with 82% of other research conducted in association with the construction industry.

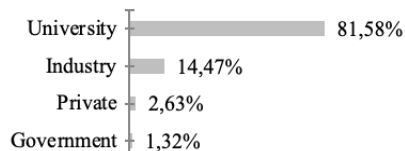


Fig. 2 Sector type

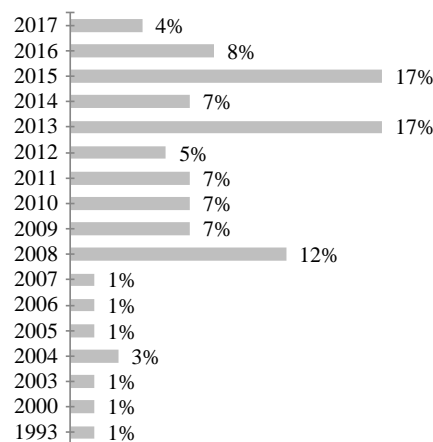


Fig. 3 Publication year of the literature

84% of the research themes were related to research papers, surveys and interviews and literature reviews (Table 2).

Table 2: Publications by Main Topic and Origin

Origin Country	Green Building	Product Innovation	Building Materials
Africa	4	0	0
Asia	10	1	0
Aus/NZ	5	5	1
EU/UK	4	3	6
US/CAN	9	5	5
Total	32	14	12
Origin Country	Market Barriers	Embodied Energy	Building Health
Africa	3	0	0
Asia	2	0	0
Aus/NZ	0	2	1
EU/UK	3	0	0
US/CAN	4	1	2
Total	12	3	3

The variety of literature reviewed is shown by topic and origin in Fig. 4a. Secondary qualitative data contained in this literature was reviewed and codified. The subsequent analysis identified common categories into which data was grouped and frequencies measured. This resulted in the following categories: key green building industry drivers, common barriers to product adoption, the attributes of green building products and factors that may guide diffusion of a green building product to becoming mainstream. The analysed data also identified other categories including key industry players and their potential influence in the selection of green building materials and at which stage of construction decisions were made concerning the utilisation of green building materials for a project. Specific details of the results including categories and their frequencies are contained in appendix 1.

Fig. 5 shows the key market drivers and their frequencies. Market drivers were found to fall into 3 main categories: (1) Social; (2) Environmental; and Economic. Societal concerns regarding the environment such as climate change, the impact conventional practices and materials have on human health and the sustainable use of materials. The resultant government intervention policies and regulations as well as voluntary green rating schemes and economic concerns about the increasing cost of energy used to extract materials to manufacture building products and construct and operate buildings rate among the most prominent market drivers.

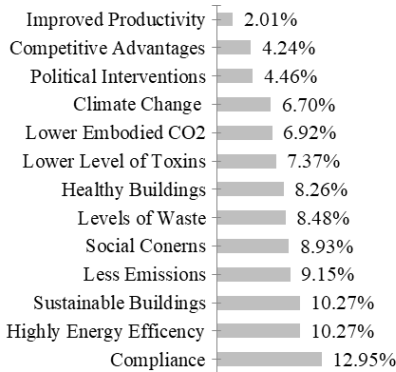


Fig. 5 Green Building Market Drivers

Fig. 6 highlights the top 4 barriers to the adoption of green building products. They are the risk to businesses using these products, the perception that these products cost more and that greater skills are required while tried and tested materials and methods are the preferred norm. In other words, this indicates the market is risk adverse and resistant to adopting the use of green building materials.

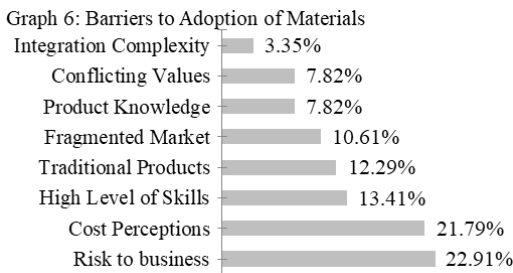


Fig. 6 Barriers to Adoption of Materials

The research papers and industry reports examined contained significant data based on surveys and research that pointed to which attributes of building products were necessary to be deemed a green building product acceptable to the market. The categories that formed as a result of the analysis, shown in Fig. 7, indicate that products are required to be energy efficient, use sustainable materials, result in healthy building environments, cost less, simple and easy to integrate into existing construction practices and conform to building regulations.

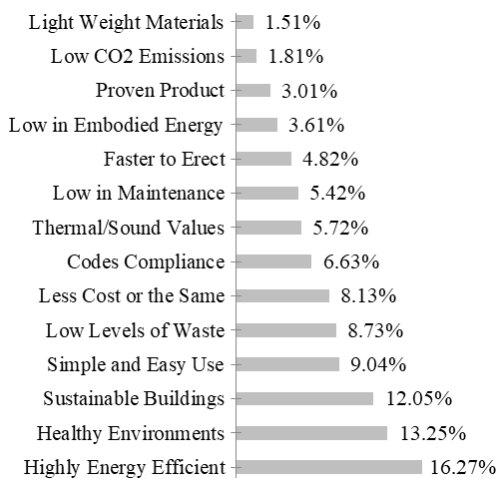


Fig. 6 Product Attributes to Meet the Market

The identification of key market players and their influence regarding the choice of building materials also resulted from the analysis. Architects, residential builders and contractors were found to have the most influence over the selection of building materials as shown in Fig. 8. These players together with the identified product attributes may provide an

understanding of the criteria for the selection of the building materials. It may also offer insights into enabling market segmentation based on the jobs the hemp-lime composite products get for key players.

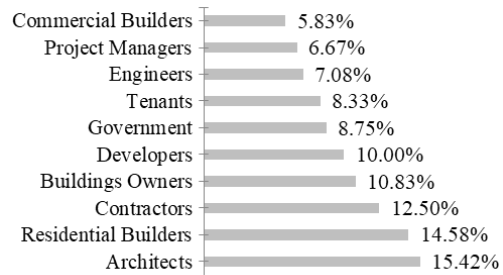


Fig. 8 Key Market Player and Influencers

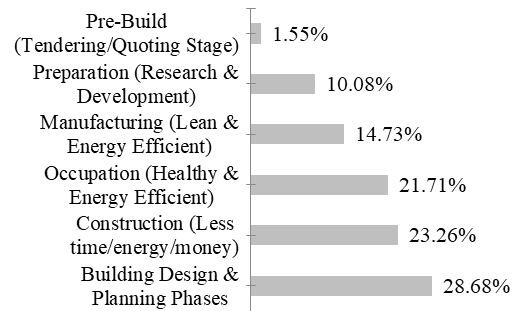


Fig. 9 Consideration of Sustainable Materials at Building

Fig. 9 shows the building development stages from manufacturing of building materials to design of the building through to completed construction. It was found that the selection of green building materials for building construction projects occurred primarily during the design phases of development. Architects and residential builders are involved in the design phase. Comparing data from Fig. 8 and Fig. 9 a correlation exists between the frequencies of market players (Fig. 8) and the selection of material during the design and construction stages of buildings (Fig. 9) suggests that architects and builders have significant influence over the selection of building materials for a project.

As highlighted in Fig. 10 the lack of product knowledge of green building materials in the market is significant.

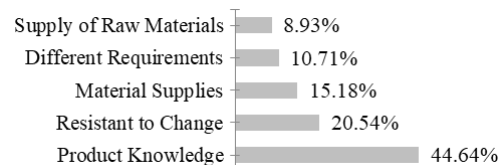


Fig. 10 Market Challengers for New Products

This is further reinforced by adoption and diffusion techniques, outlined in Fig. 11, required to achieve industry acceptance and use of green building products. Educating customers, ranked highly, and their clients may solve the lack of product knowledge in the market. Engagement of the market through product demonstrations, working with innovators and champions may result in discounting the perception of higher product costs and high risks of product use thus addressing the barriers to market penetration show in Fig. 6.

Qualitative data analysis showed that there is a close correlation between market drivers and product attributes. The attributes of a product appear to address the concerns shown by the drivers. For example, the rising cost of energy was found to be the most frequent market driver while using products that result in highly energy efficient buildings are the most frequent product attribute.

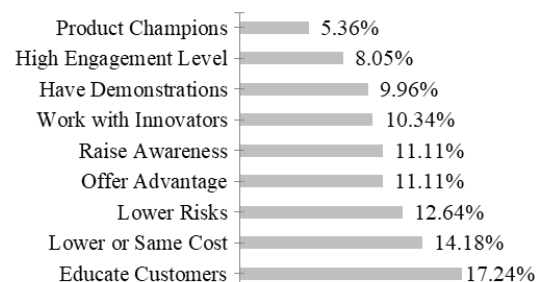


Fig. 11 Market Adoption and Diffusions

The data suggests that barriers to adoption of green building materials (Fig. 6) and associated market adoption challenges (Fig. 10) may be counteracted [1] by ensuring a product attribute satisfies the market (Fig. 7); [2] working with market players with high level of influence over building materials selection, such as architects and builders (Fig. 8); [3] using some of the adoption and diffusion techniques of innovative products (Fig. 11), [4] at key building development stages including design and construction (Fig. 9).

4.2 Data analysis

Fundamental to answering the research question were four areas of inquiry: (1) are current and projected market conditions favorable for a product becoming mainstream; (2) what the common barriers to market adoption are; (3) what product characteristics are likely to address market segment's needs; and (4) what criteria will guide the development of product adoption and diffusion strategies.

Analyses of the data have provided a comprehensive understanding of market conditions and factors that drive the market and those that influence the adoption and diffusion of products. These require careful consideration with respect to understanding the job the product does for the customers in the target market and developing the customer value proposition accordingly. The development of marketing strategies is equally import to ensure product adoption and diffusion by engaging key market segments at the appropriate phases of development.

The research highlighted that knowledge and education of customers, and their clients is a critical component of successful market penetration and adoption.

5. Implications And Recommendations

The findings show that the green building industry represents an attractive proposition for hemp-lime building products. This is evidenced by sustained and projected industry growth, high demand for green building materials and low barriers to entry (Dodge 2016). However, because of an organization's existing weakness, shown in the SWOT analysis, the fragmented nature of the construction industry and its resistance to change successfully commercialising and introducing a new green building product will face many challenges.

There are very compelling reasons why the green building industry has emerged so rapidly. The impact of buildings on the environment is enormous, including the use of raw materials and energy prior to and during construction phases and over their operational life. Globally buildings consume 40% of natural resources and use 70% of all electricity produced. Their waste contributes to about 50% of the amount of all landfills. The expected global population increase to 9 billion by 2035 will also add exponential pressures to the natural environment (Franzonia 2011). This situation has led governments to develop policy interventions to mitigate the serious impacts on the planet and the consequences for its population (Franzonia 2011). The finding of this research further supports these facts.

Green building materials are those described as not posing a risk to human health and classified as sustainable across their entire life cycle (Franzonia 2011). Sustainability is summarised as using renewable natural resources without depletion and engaging in practices that aren't detrimental to the planet or future generations (Kuhlman & Farrington 2010). Under the Australian Trade Practices Act legal liability rests with those that manufacture or import goods that result in damage or injury (Evan 2008). This has serious implications for manufacturers and suppliers of building materials and necessitates risk management in the development, use and selection of building materials.

The selection of green building materials has become very complex (Cristina et al 2014) and means more than just ensuring a project meets regulations or voluntary standards. Sustainability of a building product can be measured using a life cycle analysis. The process determines the amount of energy over the product's life. This is commonly referred to as embodied energy (Cristina et al 2014). This includes energy used in the acquisition of raw materials, manufacturing processes, transport requirements, construction of the building, its occupation and demolition (Franzonia 2011). Traditional building materials, such as concrete, is considered to be high in embodied energy whereas materials like, hemp lime composites, are considered to be low in embodied energy. Comparisons with hemp-lime and similar concrete walls show they require 32% more energy, and the production process releases over 50kg of CO₂ emissions while the hemp wall sequesters 14–35 kg/m² of CO₂ over its life span (Walker & Pavia 2014). Therefore, the life cycle of hemp-lime composite products matches sustainability requirements of building projects.

It is important to engage with builders and their customers in order to further product adoption. When builder's customers have a good knowledge of better materials the builder normally adopts the use of the

material in contrast to large builders that tend to adopt the use of the materials if the cost is lower or comparable (Koebel et al 2004).

The following recommendations are made based on the findings.

The product needs to present a low risk to its customers in terms of: legal liability; continued product supply; comparable or lower costs; sustainability and; code compliance.

Using the identified barriers to adoption, develop strategies that aim to educate the target market and their customers. This should include architects and residential builders as they are most influential in the decision to select building materials.

Establish a variety of channels to market by engaging innovative builders that act as champions to demonstrate and promote the product.

Develop customer value proposition based on the job the product gets done for the customer.

6. Conclusions

The research has uncovered a specific package of factors that influence the development of strategies aimed at successfully commercialising new and innovative products into the green building market. Detailed analysis leading to an understanding of these factors can be used to guide the development of hemp-lime composite products offerings to the target market while working toward becoming a mainstream building product in the construction industry.

It is imperative for any organization to understand market drivers and the links to market barriers and challenges. The identified barriers to adoption of green building materials and associated market adoption challenges require counteraction by ensuring product attributes satisfy market and customer demands. This enables the development of matching customer value propositions. Working together with market players that have a high level of influence over building materials selection, such as architects and builders, can act to support the adoption and diffusion of innovative products utilising various techniques during building design and construction stages.

Understanding these influential market factors can assist the case organisation to capitalise on its strengths and overcome its weaknesses thereby generating the potential to take full advantage of identified opportunities and combat the threats to create and sustain a competitive advantage in the green building market.

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