



Swedish University of Agricultural Sciences
Faculty of Forest Sciences

Department of Forest Products, Uppsala

**Market analysis for glulam within the Swedish
construction sector**

*Marknadsanalys för limträ inom den svenska
byggbranschen*

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Keywords: Glulam, Construction sector, Influence, Competitive advantage

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*Supervisor SLU, Department of Forest Products: Anders Roos
Examiner SLU, Department of Forest Products: Mats Nylinder*

Abstract

Glulam's position at the Swedish market for building constructions has been established over the past decades. Factors affecting glulam demand are found both in global and national contexts as well in customer attitudes and knowledge of the material. Arguments for environmentally friendly and sustainable construction processes and energy-efficient designs are nowadays common, which is something that should motivate increased usage of wood as a renewable material. For the glulam industry to increase its sales, improve profitability and thereby gain market share in present competitive climate, reliable market information and updated market intelligence is required.

The aim of this work was to enhance the understanding of factors affecting the demand for Swedish glulam on the domestic market. This by looking at the factors: glulam sales, construction activity, commodity prices and currency changes. It has been investigated how actors within the Swedish construction sector value their own possibility to affect construction material and also how these actors perceive existing glulam offerings in comparison to other construction materials.

The report shows that the market share for glulam increased in 2007 and has since then remained constant in relation to the total construction activity. Explanations to the market share gain can be contemporary increases in import prices of metal frames and an increased share of building activity related to industry/storage buildings. A contemporary strong SEK in relation to the Euro may also have justified an increased proportion of sales to the domestic market.

Of the total construction activity the share of multi-family and industry/storage buildings has increased while the share of single-family houses has decreased. Among all construction types the number of industry/storage projects is highest while multi-family houses are valued highest. Given that the total construction does not increase, market share gains can be made by approaching new customer segments or by increasing sales to existing customers.

Architects and constructional engineers perceive they have influence of material choices while developers feel they both influence and decide on what material to use. The study indicates that actors who previously bought glulam tend to buy again, while those who have not previously bought glulam do not intend to buy in the near future. The most prominent competitive advantages for glulam, in comparison to steel and concrete, are the environmental aspect and the experience for the end user. Toughest competition concerns construction technology aspects.

Keywords: *Glulam, Construction sector, Influence, Competitive advantage*

Sammanfattning

Limträets position på den svenska marknaden för byggnadskonstruktioner har etablerats under de senaste decennierna. Faktorer som påverkar efterfrågan hittas både i globala och nationella kontext likväl hos kunderna och deras uppfattning och kunskap om limträ. Argument för miljövänligare byggprocesser och energisnåla konstruktioner är numera vanligt förekommande, vilket är något som bör tala för trä som förnybart material. För att limträindustrin ska öka sin försäljning, förbättra lönsamheten och därigenom vinna marknadsandelar i rådande konkurrenssklimat krävs tillförlitlig marknadsinformation och aktuell omvärldsanalys.

Syftet med arbetet har varit att öka förståelsen för de faktorer som påverkar efterfrågan på den inhemska marknaden för svenskt limträ. Detta genom att titta på faktorerna: limträförsäljning, byggaktivitet, valuta och råvarupris. Utöver det har undersökts vad byggbranschens aktörer anser sig ha för möjlighet att påverka val av material och leverantör samt vad befintliga limträerbjudanden har för fördelar och nackdelar i jämförelse med andra konstruktionsmaterial.

Arbetet visar att marknadsandelen för limträ ökade under 2007 för att sedan bibehållas i förhållande till den totala byggaktiviteten. Förklaringar kan vara samtida ökningar av importpriset för stål samt ökad andel byggaktivitet relaterad till industri- och lagerbyggnader. En samtida stark svensk krona i relation till euron kan ha motiverat en ökad andel försäljning till den inhemska marknaden.

Av det totala byggandet ökar andelen flerfamiljshus och industri/lager-byggnader på bekostnad av enfamiljshusen. Av samtliga byggnadstyper byggs flest industri/lager-byggnader medan värdet är högst för flerfamiljshusen. Givet att totala byggandet inte ökar måste nya kunder hittas eller försäljningen öka till befintliga kunder för att limträindustrin ska vinna marknadsandelar.

Arkitekter och konstruktörer anser sig ha möjlighet att påverka materialval medan byggherrar anser sig både påverka och besluta om vilket material som ska användas. Studien indikerar att aktörer som tidigare köpt limträ tenderar att köpa igen medan de som inte har tidigare erfarenheter av limträ inte har för avsikt att köpa limträ inom den närmsta tiden. De mest framträdande konkurrensfördelarna som limträ innehar i jämförelse med stål och betong berör miljövänlighet samt upplevelsen för slutkund. Hårdast konkurrens råder gällande konstruktionstekniska aspekter.

Nyckelord: Limträ, Byggbranschen, Inflytande, Konkurrensfördelar

Preface

*“I Sverige har **limträ** ännu icke vunnit den uppmuntran varav det är förtjänt, och detta är så mycket beklagligt som byggnadskostnaderna härstädes blivit uppdrivna till en sådan höjd att varje möjlighet för deras sänkande borde hälsas med tillfredsställelse. Ur nationalekonomisk synpunkt borde det även vara en stor betydelse att få **limträ** införd härstädes, då alla de råmaterial som användes därtill förefinnes i riklig mängd inom landet under de att det vid järnkonstruktioner åtminstone alla grövre järnbalkar måste importeras utifrån. Det torde vara tvivelaktigt om det finnes något land som har större naturliga förutsättningar för **limträ** än just Sverige.” ”Knappast värdigt ett land som gärna vill anse sig äga de bästa ingenjörer i världen”*

The citation originates with “reinforced concrete” instead of “glulam” but can with the exchange of words show how strikingly well it fits with the current situation for the Swedish construction sector and the glulam producers. Ivar Kreuger, was the front figure and revolutionary of reinforced concrete in Sweden in the beginning of the 20th century. The citation originates from his article in *Teknisk tidsskrift* 1907 named ”Erfarenheter från Nordamerika angående armerade betongkonstruktioner” concerning the reinforced concretes great potential in Sweden. (P3 Dokumentär, 2013)

The host organization for this study has been Swedish Wood (Svenskt Trä), a part of the Swedish Forest Industries Federation. It aims to “spread knowledge, provide inspiration and encourage development relating to wood, wood products and wooden buildings” and it also “aims to highlight wood as a competitive, eco-friendly and sustainable material”. (Swedish Wood, 2014a) Swedish Wood represents the wood based industries in Sweden including today’s four producers of glulam products. These four companies are: Glulam of Sweden AB, Martinsons, Moelven Töreboda AB and Setra Group which together form Svenskt Limträ.

I would like to thank Mikael Eliasson and Johan Fröbel at Swedish Wood for giving me the opportunity to conclude my time as a student with this inspiring work related to the high end market for forest products. My thanks also go to each of the glulam companies and their representatives for supplying information and supporting my research. My sincerest greetings go to my supervisor Anders Roos at the Department of Forest Products, for giving me support and directing my research along the winding way from research idea to final conclusions.

Last but not least, I would like to thank my family in Västerbotten for always being there and supporting with unconditional love.

Johan Larsson
Uppsala, June 2014

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1 Introduction

1.1 Background

The competitive situation for Swedish wood processing industries has been an issue of concern and demand on previously reliable markets has due to changing macro-economic factors lowered. The glulam industry is one of the industries where the competition within the industry and between other industries is toughening. (Niklasson¹) This industry depends heavily on construction activity since the main share of products goes to frames, beams and other structural building elements (Carling, 2008). The global glulam demand has recovered since the big financial drop in 2008 but has remained unchanged from 2010-2012. The situation on the European market is the same except for 2012 when the demand lowered. (UNECE, 2013) The Swedish demand also decreased in 2012 and did not recover in 2013. (Figure 2, p. 11) (Swedish Wood, 2014b)

Efforts have been deployed by industry associations and individual companies to increase the visibility and the knowledge about glulam as a substitute for materials such as steel and concrete, especially in larger constructions and multi-story houses. (Swedish Wood, 2014c) Besides a great share of gross domestic product (GDP) the construction sector today accounts for a great share of emissions and energy consumption (Energimyndigheten, 2013). According to Nelson et al. (2010), the building sector in Europe is responsible for the largest share of the European Union's energy consumption (42%) and account for 35 percent of the total green gas emissions. Glulam can, as a renewable and carbon sequestering material, contribute to a lower climate impact for the sector at the same time as creating effective business opportunities. (Nord and Widmark, 2010)

To gain market shares and increase profitability for the glulam industry in this harsh competitive climate, reliable market information and coordinated business intelligence are important. This study aims to enhance present glulam market understanding through quantitative research within the Swedish construction sector. With ambition to identify factors that are affecting the demand for Swedish glulam on the domestic market and also to identify the main strengths and weaknesses of present glulam offerings, in comparison to other construction materials.

1.2 Glulam

Glued laminated timber (glulam) has been produced in Sweden since the beginning of the 20th century. The products consist of wooden lamellas which are glued together to form beams and poles mainly used in constructions. The idea of glulam compared to ordinary constructional timber is to limit the impact of knots or other weaknesses by compressing lamellas. The production of glulam has been made more effective and the material is used in large as well as in small constructions within many areas, e.g. sport arenas, multi-story houses and warehouses. (Carling, 2008)

The production process for glulam (illustrated in Figure 1) starts with sawing and drying of softwood lumber. The sawed lumber is then sorted based on quality, to fit standards of the final product. After sorting, a finger jointing process merges the lumber into lamellas which then are planned to eliminate any irregularities. The next steps in the process are gluing and compression of lamellas to glulam elements to demanded dimension. A final planing before

¹ Magnus Niklasson, Marknadsanalytiker Trä, Skogsindustrierna, pers. comm. 2014-03-20

packaging is the last step of the process and leaves the glulam element with a plane and homogenous surface. (Carling, 2008)

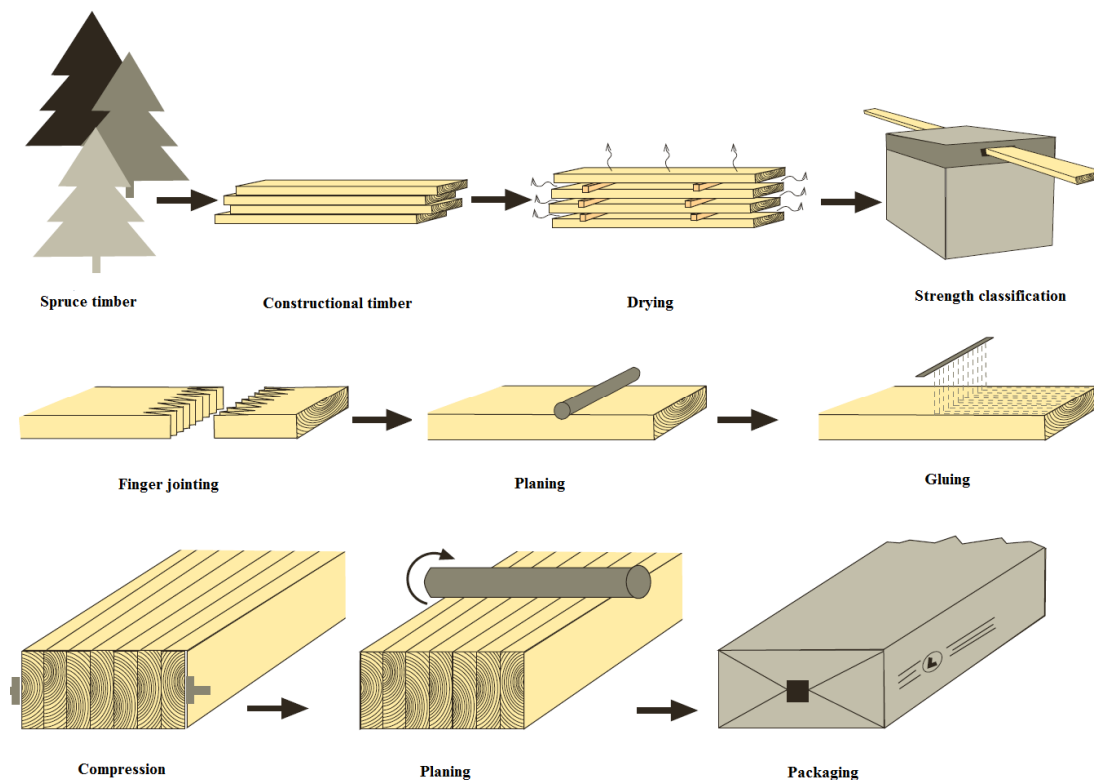


Figure 1. Schematic picture of glulam production. Translated from *Limträhandboken* (Carling, 2008)

Strength in a construction material includes push, pull, shear and bending properties. The strength of the wooden material is dependent on both internal and external factors. Internally the density and the fiber structure will affect the strength while external factors for example are humidity and temperature. Also the way in which the pressure is put on a specific piece of wood in relation to its fiber direction will affect how much the construction can bear. Natural deficiencies in strength might be knots and similar natural occurrences which can be excluded with modern sawmill technique. (Swedish Wood, 2014c) Glulam carries properties of high strength per weight unit compared to other construction materials such as steel and concrete. The light weight wood demands greater volume, than for instance steel, to manage same construction loads. (Carling, 2008)

Durability classifications are made based on push and pull resistance, bending performance, stiffness and density. In 2011 the classification scheme Eurocode 5 was introduced in Sweden, which includes all wooden constructions. Adaptations to the classification schemes made it possible for European customers to measure and design their projects on a general standard. These standards did not change the production for the Swedish suppliers since their quality was already high for the Nordic produced glulam. (Svenskt Trä, 2012)

Glulam products can be divided in to two categories characterized by different levels of involvement by the producer in the customer's process. These two groups are "standard glulam" and "custom glulam". Standard glulam is a product defined as glulam beams and pillars sold to building merchants, wood retailers and single-family house manufacturers and include services as pre-cutting, distribution, education and dimensioning tools. It is sold based on price per cubic meter. Custom glulam is building systems and projects consisting of beams

and pillars in constructions such as multi-story houses, arenas and wooden bridges. The building systems and specific design projects are established by the glulam producer together with its customer. The level of involvement by the producer varies depending on customer preferences and knowledge as well as product complexity. Curved beams are also included in this group. Custom glulam is in similarity to standard glulam sold based on price per cubic meter. (Fröbel²)

1.2.1 Glulam competitive advantage

Arguments commonly used for wood, including glulam, in constructions are (Swedish Wood, 2014c):

- Constructional
 - High strength per weight unit
 - High flexibility enabling various number of construction types
 - Predictable fire resistance
 - Dry and quiet construction sites
 - Great potential for prefabrication
- End user comfort
 - High isolation capacity, both warmth and cold
 - Easy mounting in walls etc.
 - Esthetical pleasing (scent, looks and feeling)
- Environmental
 - Low or zero carbon dioxide emissions
 - Renewable material

1.2.1.1 Constructional

High strength per weight unit enables wide construction spans and durable constructions. It also makes transportation of larger construction elements possible which in turn allows such elements to be efficiently produced at each industry. (op. cit.)

Concerning fire resistance, glulam does regardless of surrounding temperature during a fire burn at a slow and constant speed. This makes predictions of how long the bearing constructions can withhold very accurate. In this way any fire extinguishing missions can be planned and conducted safely. This in comparison to steel constructions which are associated with unpredictable fire resistance or expensive flame retardants. (op. cit.)

A dry and quiet construction site gives better working conditions for the entrepreneurs. In comparison to concrete which is a wet substance demanding time for drying, wood can be assembled dry and fast. Concerning sound levels is wood, in comparison to steel, absorbing more and creating less noise. (Karlsson³)

1.2.1.2 Living

Wood has a relatively low thermal conductivity giving it properties of high temperature isolation. Since wood is processed with simple tools, another argument pro glulam is the easiness to mount and remount any decorations and furniture for the end user. Esthetical pros and cons are of course a question of individual taste and preference. Wood offers the feeling

² Johan Fröbel, Senior Advisor Swedish Wood. pers. comm. 2014-01-13

³ Stefan Karlsson, Folkhem. Study visit Swedish Wood Building Council 2014-01-23

of a living material of natural origin, a material with scent and appearance that might attract people to live in the buildings. ((Swedish Wood, 2014c))

1.2.1.3 Environmental

Wood is a renewable material which in Sweden originates from sustainably managed forest. The trees capture carbon dioxide during its growth which can be stored in wooden products and constructions. Life cycle assessments (LCA) of construction materials show that wood has a great advantage compared to other commonly used materials. (op. cit.; Färlin, 2009)

A number of certification schemes are rising within the construction sector to embrace present environmental concerns. Certification schemes for environmental impact related to the construction sector have recently bloomed. In Sweden today there are four main schemes: EU GreenBuilding, Miljöbyggnad, BREEAM-SE and LEED. The EU GreenBuilding assesses energy consumption whilst Miljöbyggnad additionally regulates material and indoor environment. The other two schemes are comprehensive and control for example water consumption, construction waste, infrastructure, pollution, the building process and innovations. (Sweden Green Building Council, 2013) The two later schemes include aspects where modern wood constructions have competitive advantage ((Beyer et al., 2011; Karlsson⁴; Reid et al., 2004)

The named certification schemes are not directly motivating increased usage of wood but rather a more sustainable way of building and living. It is up to the forestry sector and more specifically the glulam producers, to take advantage of the increased environmental concern and promote their environmentally friendly products. In Sweden the building sector and the households account for 24 percent of the annual energy consumption based on 2012 statistics (Energimyndigheten, 2013). These great shares of total consumption indicate a great potential of reducing the total climate impact of the EU, including Sweden, through low-energy buildings and by building sustainably.

1.2.2 Glulam's perceived competitive disadvantage

Wood, including glulam, is an organic material and can during specific circumstances, depending on mainly temperature and humidity, be receptive for microorganisms (Carling, 2008). Defects that can occur are rot, fungi and mold. This makes it biodegradable if not used and managed properly. The organic aspect also makes it possible for wood to absorb and emit water which affects the size of the material. Such size differences can occur with changes in humidity and will result in movements in the material. Wood naturally includes asymmetries which can affect properties of the final product. Such could be knots, changed fiber angles and resin galls. In glulam these deficiencies have been eliminated through the "lamelling effect" and surface treatments can also be applied to reach esthetical and water repellent demands. Correct constructions and handling can also limit these affects to go unnoticed. (op. cit.)

The fact that wood burns can be seen as a disadvantage since it potentially can add fuel to fires in constructions. Other materials such as steel and concrete do not carry these properties but steel specifically can instead change its bearing capacity rapidly depending on the fire temperature. Arguments against wood's fire resistance is or has been common among end users. (Gold and Rubik, 2009)

⁴ Stefan Karlsson, Folkhem. Study visit Swedish Wood Building Council 2014-01-23

Lack of knowledge among construction supply chain actors on how to use and manage wooden construction effectively might be a disadvantage for glulam (Björnfot, 2006; Sard, 2005). Not in the material itself but rather for correct usage of the material and for gain of market shares.

1.3 The Swedish market and its actors

1.3.1 Market environment

Sweden's consumption of glulam has fluctuated since 2003 with a dip in sales since 2011 (Figure 2). Similar variations can be seen on the European market but the recent years' decreasing trend is not as obvious as in the Swedish market. From 2003 to 2013 the European demand increased by approximately 80 percent whilst the same number for the Swedish market is only 43 percent. On the global glulam market the recent years' dip cannot be seen, as a re-allocation of consumption from Europe to Asia has sustained the global apparent consumption. (UNECE, 2013)

The importance of the Swedish market for the domestic producers should not be underestimated since traditional European markets have lowered their demand, much due to financial instabilities and weak currencies compared to the SEK. Present currency rating SEK-EUR (2014-03-20) is today eight percent below average, giving exporting industries, such as the forest industry, eight percent lower margins on exported products compared to them sold on the domestic market. (Niklasson⁵)

Swedish buyers of glulam are builder merchants as well as private and public construction companies (Högsborn, 2007). The main areas of usage are constructions of single- and multi-family homes and non-residential buildings, such as storages, stores, offices and arenas. Together these segments account for 60 percent of the glulam consumption. The remaining share is used for other constructions such as bridges, car parks, boat masts and power line poles. (Carling, 2008)

The annual production capacity of glulam is currently 173 000 cubic meters of which 70 percent have been utilized in the last two years. The utilization has not been evenly distributed among the four producers with a variation of 35 to 100 percent's utilization. (Cederlöf⁶; Lindberg⁷; Lundström⁸; Åhlén⁹)

Domestic demand for glulam has varied between 37 000 and 66 000 cubic meters during the last ten years period (Figure 2). During 2012 and 2013 domestic sales share of total sales were 54 and 45 percent respectively. Of total domestic glulam sales the custom glulam share has varied between 56 and 72 percent the last eleven years. Foreign markets of importance for the Swedish glulam industry are, and have been, Japan, Germany and Norway. Japan stood in 2008 for a great majority of the exported volume with approximately 30 000 cubic meters glulam products. (Färlin, 2009) The Japanese sales have historically mainly been standard glulam.

⁵ Magnus Niklasson, Marknadsanalytiker Trä, Skogsindustrierna, pers. comm. 2014-03-20

⁶ Leif Cederlöf, Product Manager Setra Trävaror AB. E-mail 2014-04-23

⁷ Mikael Lindberg, CEO Martinsons Byggsystem AB. E-mail 2014-05-07

⁸ Anders Lundström, CEO Glulam of Sweden AB. E-mail 2014-04-15

⁹ Johan Åhlén, CEO Moelven Töreboda AB. E-mail 2014-04-28

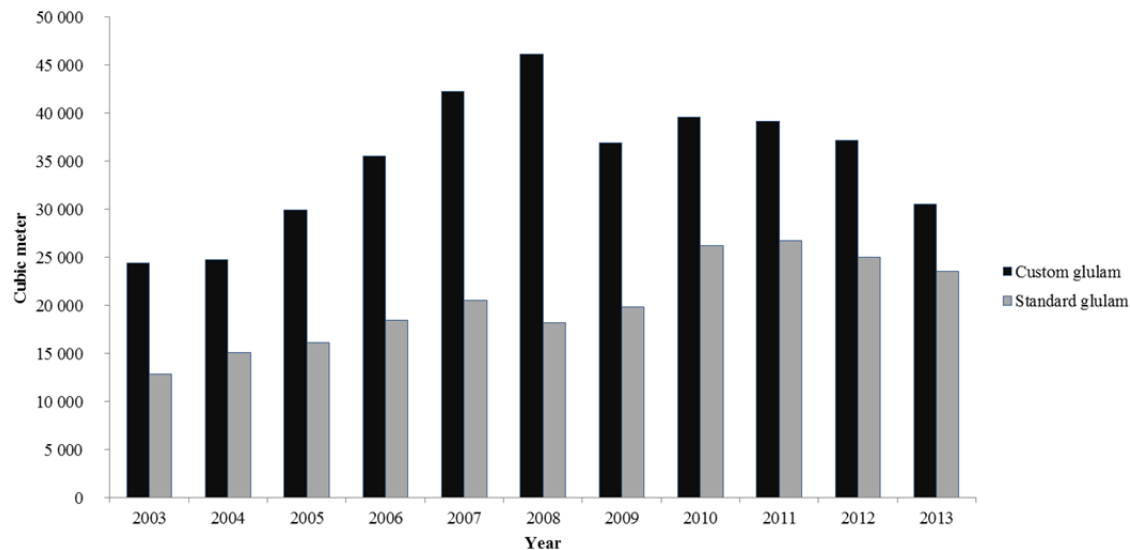


Figure 2. Variation in demand of standard glulam and custom glulam on the Swedish market from 2003 to 2013. (Swedish Wood, 2014a)

1.3.2 Suppliers

There are today four producers of glulam in Sweden, Martinsons, Moelven Töreboda AB, Setra Group and Glulam of Sweden AB. They compete on the domestic and international market by supplying glulam products and associated services. To increase demand for glulam at the Swedish construction market joint decisions have been taken among the glulam producers. Such decisions have led to publishing of information concerning pros and cons with glulam as a material and also more specific guidance on how constructions are best designed and assembled. (Fröbel¹⁰; Swedish Wood, 2014c) Company information and their respective main market focus differ and will hereon be described shortly.

1.3.2.1 Martinsons

Martinsons is a privately owned company with an independent holding company and main office in Bygdsiljum, (Västerbotten). It has five subsidiaries in the same geographical region with a wide market approach including sawmill facilities, selling organizations and further vertically integrated in the value chain are two designing and construction functions. Martinsons produces both custom and standard glulam and can by its market approach offer everything from sawn wood to designed and assembled constructions. (Martinsons, 2014) The custom glulam is primarily sold at the Swedish and the Norwegian market and the standard glulam is mainly shipped to Japan. The distribution of sold glulam volume is approximately 50 percent to Sweden and the rest to other markets. Martinsons production capacity of glulam is approximately 70 000 cubic meters annually and in 2013 the consolidated turnover was 1 300 million SEK of which 23 percent could be related to its glulam sales. Its main customer segments are construction companies (custom glulam) and builder's merchants (standard glulam). In 2013 it had 435 employees. (Lindberg¹¹)

1.3.2.2 Moelven

Moelven is a Norwegian limited company with production units in both Norway and Sweden and its corporate divisions are Timber, Wood and Building systems. It offers a wide span of products including sawn wood as well as complete construction solutions. Its Swedish glulam

¹⁰ Johan Fröbel, Senior Advisor Swedish Wood. pers. comm. 2014-01-13

¹¹ Mikael Lindberg, CEO Martinsons Byggsystem AB. E-mail 2014-05-07

production is placed in Töreboda (Västra Götaland) and acts under the business division Building systems. Sweden is Moelven Töreboda's main market and stands for 90 percent of the glulam sales; UK has the remaining 10 percent. A previously important market was Japan, with 20 000 cubic meters glulam sales, which now is abandoned in advantage for the Swedish market. Customer segments are builder merchants (standard glulam) and construction companies (custom glulam). Approximately 80 percent of the incomes are derived from the Scandinavian market. (Moelven, 2013) The consolidated turnover for 2013 was 8 792 million SEK¹² of which 5 percent could be related to glulam sales, both Swedish and Norwegian. The total number of employees was 1460 of which 239 related to glulam production and sales. 120 of these were employed at Moelven Töreboda AB in Sweden. (Åhlén¹³)

1.3.2.3 Setra Group

Setra Groups' (Setra) organization is divided in the two business areas Sawn wood products and Building products & systems of which its glulam production in Långshyttan (Dalarna) acts under the second (Setra, 2014a). Its annual production capacity is approximately 38 000 cubic meters of which 29 000 were utilized in 2012 (Setra Group, 2013). Roughly 20 percent of its production is sold at the Swedish market whilst the other 80 percent goes mainly to Germany, UK, Japan and Italy (Högsborn, 2007; Setra, 2014b). Customer segments are builder merchants (standard glulam) and construction companies (custom glulam). Setra's integration in the value chain concerning glulam includes deliveries and supply of building systems. Moreover the Setra Group produces modular houses and other wooden construction solutions not including glulam. In 2013 Setra had 908 employees and a consolidated turnover of 4 068 million SEK. How many of these numbers that are related to glulam sales is unknown. (Cederlöf¹⁴)

1.3.2.4 Glulam of Sweden AB

Glulam of Sweden AB (Glulam) is the latest addition to the Swedish glulam producers. It has been producing glulam since 1998 and is situated in Ljungaverk (Västernorrland). The company is specialized on glulam and does not produce any other wood based products. A recently added product is the building system Loglock® which is glulam logs assembled as a construction kit. Present market is local around the production unit but an approach towards southern Sweden is being made. The foremost customer segment is construction companies. Competitiveness is gained by fast and on time deliveries and through flexibility. (Glulam of Sweden AB, 2014) Its production capacity was in 2013, 5.000 cubic meter glulam. Under the same year it sold 2.700 cubic meters glulam, an increase of 600 cubic meters from the previous year. In 2013 the company had a consolidated turnover of 15 million SEK of which 95 percent were related to glulam sales. The number of employees was 10. (Lundström¹⁵)

1.3.2.5 Summary

The following table summarizes the four glulam producers' features.

¹² Exchange rate SEK-NOK =1.0977, 2014-05-07

¹³ Johan Åhlén, CEO Moelven Töreboda AB. E-mail 2014-04-28

¹⁴ Leif Cederlöf, Product Manager Setra Trävaror AB. E-mail 2014-04-23

¹⁵ Anders Lundström, CEO Glulam of Sweden AB. E-mail 2014-04-15

Table 1. Summary of glulam producers features. (Cederlöf¹⁶; Lindberg¹⁷; Lundström¹⁸; Åhlén¹⁹)

Features/Company	Martinsons	Moelven Töreboda AB	Setra Group	Glulam of Sweden AB
Geographical placing	Bygdsiljum	Töreboda	Långshyttan	Ljungaverk
Main markets	Sweden, Norway, Japan	Sweden, UK	Sweden, Japan, UK, Italy	Local
Products	Standard beams, Custom beams	Standard beams, Custom beams	Standard beams, Custom beams	Standard beams, Loglock®
Production capacity 2013 (cubic meters)	70.000	60.000	38.000	5.000
Total sold volume 2012 and 2013 respectively (cubic meters)	60.000/60.000	24.600/21.000	29.000/38.000	2.100/2.700
Consolidated turnover (million SEK)	1.300	8.792	4.068	15
Employees	435	1460	908	10

1.4 Problem discussion

The demand, for custom glulam produced in Sweden, at the Swedish market has seen a substantial decrease since 2011 for which the reasons are partly unknown. The demand for custom glulam has decreased to reach the same level as in 2005 which represent a decrease of almost 34 percent (Figure 2). A positive trend forecast for glulam at the Swedish market indicated by Högsborn (2007) and Fallgren (2010) has not been materialized. This has made the Swedish glulam industry rethink its situation and consider which strategies to use (Eliasson²⁰).

1.5 Purpose

The main purpose of this report is to enhance the understanding of factors affecting the demand for Swedish glulam on the domestic market. This is divided into following sub-objectives:

1. Identify correlations between construction activity, commodity prices, currency changes and glulam sales to understand market dynamics and market share fluctuations.
- 2.1 Describe how actors within the Swedish construction sector value their own possibility to affect the choice of construction material and also how these actors perceive present glulam offerings in comparison to other construction materials.
- 2.2 Identify the main strengths and weaknesses of present glulam offering to enhance understanding of present Swedish glulam market and create competitive edge for glulam in comparison to other construction materials.

¹⁶ Leif Cederlöf, Product Manager Setra Trävaror AB. E-mail 2014-04-23

¹⁷ Mikael Lindberg, CEO Martinsons Byggsystem AB. E-mail 2014-05-07

¹⁸ Anders Lundström, CEO Glulam of Sweden AB. E-mail 2014-04-15

¹⁹ Johan Åhlén, CEO Moelven Töreboda AB. E-mail 2014-04-28

²⁰ Mikael Eliasson, Chairman Swedish Wood, pers. comm. 2014-01-13

1.6 Study questions

For part purpose one, the following questions are asked:

- How do building activity, commodity prices and currency values affect the Swedish glulam sales?
- Which macro environmental variables have during the last 11 years affected the domestic glulam sales the most?

For part purpose two, the following questions are asked:

- How do actors within the construction sector perceive their own possibility to affect material selection depending on their role as Demander, Designer, Performer or Controller?
- Where do actors within the construction sector consider glulam to have most advantages compared to steel and concrete?
- Where do actors within the construction sector consider glulam to have most disadvantages compared steel and concrete?

1.7 Literature Review

1.7.1 *Material properties and selection*

When it comes to material selection in buildings, Bysheim and Nyrud investigated Norwegian architects' perceptions and views on wood in constructions. Their findings show that increased usage of wood is associated with previous experiences, perceived behavioral control and attitudes. (Bysheim and Nyrud, 2009) Their study was limited to architects, who according to Roos et al., (2010) do not have such great influence in material specification. Roos et al., (2010) instead suggests that structural engineers, developers and contractors have the greatest influence on material selection, and are often biased towards concrete.

Färilin (2009) conducted a market analysis of glulam with focus on the European market. The result indicated an increasing production volume of glulam among European countries and areas such as Austria, Germany, Italy and Scandinavia. Even so, the market share compared to steel and concrete in the construction sector was considered small. Identified barriers for increased sales were lack of knowledge and misguiding presumptions. A life cycle analysis (LCA) was also conducted, comparing glulam with steel and concrete in a construction frame. The result showed nine and six times the emissions of glulam for steel and concrete respectively. (op. cit.)

Gold and Rubik (2009) made a study among the German population indicating that prejudices of glulam concerning fire resistance, durability and stability are present among the Germans. It also highlighted positive attributes of wood such as well-being, aesthetics and eco-friendliness which were not considered enough to motivate a deliberate selection of housing frame.

1.7.2 *Service, knowledge and information*

The situation for the glulam industry can also be put in light of competitive advantage on niche respectively mass markets. The aim for the industry to increase the Swedish demand (Eliasson²¹) will likely move the industry from a market characterized by a niche market to a

²¹ Mikael Eliasson, Chairman Swedish Wood, pers. comm. 2014-01-13

mass market. Such development could form the competitive climate to focus mainly on low prices. (Hansen et al., 2002) Such development is not wanted and it is necessary for Swedish suppliers to keep the high quality products to remain competitive and enable higher prices (Svenskt Limträ²²).

Kozak and Cohen (1996) identified how North American specifiers (architects and structural engineers) learn about structural materials through a quantitative questionnaire survey. They found big differences in the amount of information on wood that the two different groups received. Lack of information was mainly found among engineers and suggested alternatives for increased knowledge were establishment of physical examples such as demonstration constructions and showcases.

Cigén (2003) aimed to analyze the communication process among construction supply actors and solid wood suppliers. The study showed that the number of involved actors is many and that different actors have various needs of information depending on their role in the value chain. The analysis showed an increased risk of dysfunctional communication in the process stages, bidding, projecting and planning. Suggested actions for smoothened business were tailored information as well as specific communication systems dependent on the confronted actor and project stage. (op. cit.)

Jakobsson and Söderström (2009) performed a master thesis with the aim to map who is the decision maker of structural systems and on which basis such decisions are made. The qualitative study showed that the economical factor is of greatest importance when it comes to selection of structural frames, which was shown favorable for glulam in comparison to steel in all investigated objects. Tradition, not including glulam, was also a major cause for present selection schemes. (op. cit.)

1.7.3 Standards

Previous research (Högsborn, 2007; O'Connor et al., 2004) show that lack of uniformed durability and strength classifications can be a trade barrier for glulam suppliers on different markets. Even though such classification schemes were established in 2011 the EU demand for glulam has not seen a substantial rise. (UNECE, 2013) The establishment of such schemes was by the Swedish industry also thought to eliminate obstacles for wood usage among customers but it was not thought to change the present quality and production of glulam since it is considered high compared to European competitors (Svenskt Trä, 2012).

1.7.4 Suggested areas of improvement

According to Fallgren (2010) glulam customers perceive value mainly derived from price, supply reliability and the overall impression when choosing between glulam suppliers independent of their experience level. Fallgren (2010) recommend glulam producers to forward integrate along the supply chain through provision of service and consulting to customers. It is also suggested that glulam producers can increase their market share in the construction sector through new customer segments which are currently not buying glulam.

Enjily and Bregulla (2004) identify barriers for increased usage of wood in general and more specific in the construction sector. They also suggests actions to be taken for an increasing demand. Among suggested actions are harmonized building codes, availability of information and promotion of change in perception and attitudes among decision makers, the most

²² Svenskt Limträ. Meeting 2014-03-20

highlighted ones. Additionally Roos et al. (2010) suggests clarified business concepts with focus on cost-efficiency, development of prefabricated constructions and increased “professional status” of wood through outstanding design constructions.

2 Theoretical framework

Theory is universal and applicable to a wide number of areas. It statues a frame for addressing specific cases and adds spine to research proceedings and its reporting. This chapter presents and motivates the selected frame of theoretical references. The purpose of this study aims for a wide understanding of glulam demand fluctuations and its relations to the construction sector. Also understanding of what stakeholders within the construction sector know and value concerning present glulam offerings in relation to other construction materials is wanted. This aim motivates two theoretical approaches. One based in market understanding including various aspects of supply and demand and related market dynamics while the other takes base in purchasing theory with focus on attitudes, knowledge and information. These theories are then merged for a more complete frame for method and analysis.

2.1 Market environment and metrics

In order to approach the study area a theoretical paradigm in which presented theories originate has to be present. It defines essentials in environmental interpretation within theoretical arguments and models to bring contemporary discourses forward in all sciences, including economic science. Parts of the purpose concerning macro-economic factors are derived from contemporary mixed economies, reflecting characters of both market economy and planned economy (Weintraub, 1993). They originate from the neoclassical economy first introduced in the early 20th century. Its fundamental basis relies on three general assumptions that one: people have rational preferences among outcomes, two: people maximize utility and firms maximize profit and three: people act independently on the basis of full and relevant information. These assumptions have guided the 20th century economy with supply and demand as the most essential market drivers and price setters (op. cit.). This in contradiction to previous classic economy characterized by pricing based on effort put down on the product rather than what it is worth for the customer (Sandelin et al., 2001).

To establish a context in which the offerings compete, defining a market and its boundaries is necessary for the study. Markets can be defined based on products with same or similar characters or area of usage. The width of the market changes over time and is mainly dependent on product specifications and product development. It is up to each firm to evaluate which is its specific market. A company's or an industry's market environment is the external context in which it acts. The environment can be described through a number of models. Kotler's (2000) model divides the environment into macro and micro environment. The macro environment is in similarity to a PEST model described through Political/Legal, Economic/Demographic, Social/Culture and Technological/Physical factors. The other part not included in the PEST model is the micro environment consisting of suppliers, marketing intermediaries, publics and competitors. Juslin and Hansen, (2002) suggest a developed model called the *Information environment model* (Figure 3) including supply and demand in the macro environment and also aggregating the previously mentioned macro factors to one, through usage of econometric instruments. The micro environment has a greater focus on customers, both industrial and final, and also includes distribution rather than suppliers. This difference gives the micro environment a more internal character rather than a close external one. Focus on the macro environment gives a coarse guidance for marketing direction and is suitable for the most overhead marketing planning. A micro approach completes the market overview through understanding of customer behavior and preferences. (op. cit.)

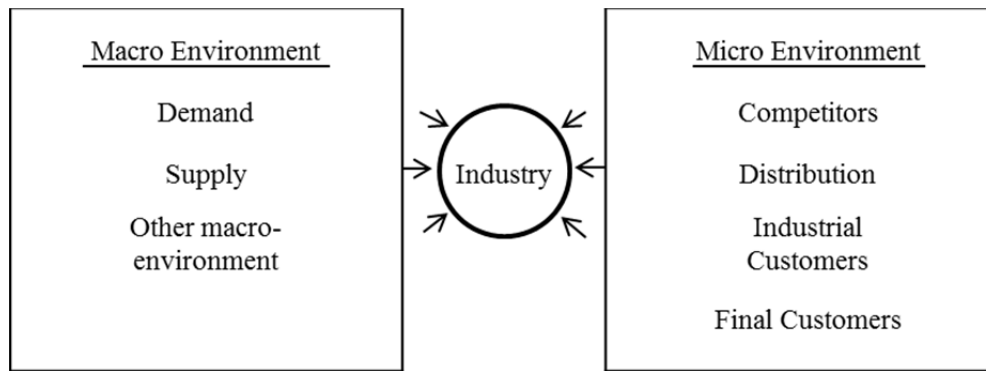


Figure 3. The Information environment model adopted from Juslin and Hansen (2002).

Originally the model is used to form marketing plans, including strategies, structures, functions and action plans. To aggregate this model to an industry's perspective these aspects is not included in this adopted model. Instead it is used to describe the environment in which glulam offerings compete. For part purpose one, focus lies on the macro factors while part purpose two includes parts of the micro environment.

Defined boundaries are not static since the environment is interchangeable over time and will change the conditions on which existing offerings compete (Grant, 2013). Trends come and go along with changes in both macro and micro environments. These are factors affecting markets, industries and private persons. To a specific firm or industry the preferences of different stakeholders will inevitably affect the firm's or the industry's actions. Historical time series of data can be observed to better understand which factors that have been affecting previous supply and demand. Findings from such observations are likely to increase the understanding of the current market situation. Depending on market presence the risk and effect of changes in market environment is more real for some than others. Differences in market presence in e.g. geographical, demographical or constructional markets will make it necessary for different firms to react diversely to keep market shares and profits. (op. cit.)

Demand in the macro environment consists of multiple factors. Such can be price on substitutes (steel and concrete) and complementing materials (paint, nails etc.). Incomes/turnover among buyers, which for this study indirectly can be represented by building activity, is also an important aspect. Demand is also affected by trends in preferences and tastes which concerning construction materials could be the latest years' increased environmental concerns. Moreover the size of the demanding population and its expectations might affect the overall demand. (Axelsson et al., 1998)

To divide homogenous markets into manageable groups' *market segmentation* is used. The segmentation should be based on criterions which clearly identify critical differences in how the choice of product is made or how it is used. Segments should also be easy to recognize for the marketers to enable efficient approaches toward the different groups. (Juslin and Hansen, 2002) Companies' and industries' market segment selection is of great importance for successful market approach and to establish corporate strategies which generate competitive edge (Tilles, 1966).

Market metrics

Market actors act on markets depending on their situation as either buyers or sellers. Basically, buyers have needs to fill while sellers have profits to earn which is something that can be traced back to the fundamentals of supply and demand. The fulfillment of these aims can be

measured through a number of metrics. Through history the science of marketing metrics has to great extent been seen as a science of social character rather than quantifiable mathematics. Recently increased availability of data through digitalization and better tools for analyzing has boosted the economic science usage of mathematics and metrics. (Farris et al., 2010) Measuring performance of actors on markets during contemporary circumstances is advantageous to other methods since they are comparable for companies, industries and markets both international and domestic. The difficulty lies in the choice of which metric to compare. Farris et al. (2010) did a metric survey among marketing managers that indicates differences in perceived usefulness among metrics. A compiled ranking shows that net profit had the highest priority followed by margin (%) and return on investment. Market share can be seen as a result of profitability, market presence and customer perception and therefore function as a secondary metrics to the ones mentioned.

Market share is defined as unit of sales for a specific entity divided by the total market unit sales. Instead of number of units the revenue on sales and the market as a whole can be used. Market share can be gained through either growth with the market or by taking share from competitors. To describe the correct market share a clear definition of the market, its competitors and the entity's information capturing is vital. If viable, a correct market share metric will monitor the competitive landscape giving hints on future opportunities or problems. Comparing competitor success with total market growth can indicate customer preferences and therefore give guidance to strategic operations for the specific entity. Gain of market share through increased total demand is generally seen as easier and less costly than captured number of sales from competitors. (Farris et al., 2010) Great market share has no intrinsic value if profitability is lacking wherefore strategic market share goals should be secondary to profitability goals. Profitability is fundamental for gaining market share and it can seldom be the other way around. (Armstrong and Green, 2007)

Market penetration is defined as the percentage of people in the target group who bought a category of goods during a specified period of time. It illustrates the popularity of a product category among potential buyers and can help managers decide whether to attract new customers to the market or acquire customers from competitors. (Farris et al., 2010)

Market concentration is the degree to which a large percentage of the market is accounted for by a small number of suppliers. A small number of suppliers' makes each supplier's specific actions affect the overall market more. Theoretically it should also indicate lower competition and be positive related to profit rates. (Farris et al., 2010)

2.2 The offering and purchasing

For the second part of the purpose, focusing on stakeholders' perceived influence, knowledge and information concerning present offering, assumptions of neoclassical character are not complete. This, since there are cultural and somewhat institutional hindrances in the modern economy restricting the market fluctuations to act freely only based on supply and demand. The fact that people are limited by a certain amount of information is an example of restriction with the neoclassical approach. (Colander, 2000) Instead as suggested by Colander (2000) the modern economy has taken over. It includes models which not only calculate on the basis of known facts and supply and demand but instead include game theory focusing on probability for specific outcomes. Game theory take base in the fact that actors do not act independently, meaning that one actor's action can and will affect another actor (Sandelin et al., 2001). The causal character of this approach is suggested (Grant, 2013) to create market understanding and economic equilibrium through specification of actors options and potential outcomes. It

serves as systematic and rational base for decision making. A part of this emerging theoretical perspective is based in extensive data mining and studying of dynamics through iterative processes that create understanding as patterns are realized (Colander, 2000). This approach is similar to the theory of econometrics (Syll, 2001).

It is with this theoretical frame further described micro economic theory is embedded. Also the later described approach to data mining for understanding of dynamics and patterns as part of the modern economy is reflected in the chosen methodology.

2.2.1 The offering

Business transactions usually include buyers and sellers bargaining for a product of physical character which in exchange for payment transfers ownership to the buyer. This simple description is though incomplete since products often include other aspects than price and availability. A more correct way of describing the transaction is through *the offering*. An offering is what a seller supplies to a customer to solve or help to solve existing problems. The offering consists of a bundle of product characters which according to Ford et al. (2006) can be divided into

- Product
- Service
- Logistics
- Information and consulting
- Pricing and cost

These characters together create the offering and can in various combinations contribute to customer satisfaction and sales agreements. The specific part is hereon described more thoroughly.

2.2.1.1 Product

Tangibility is what is recognized within this character whereas the physical characters of the offering are in focus. This is often what firstly comes in mind when thinking of product quality i.e. durability. This character specifies product size, color, area of usage etc. Traditionally, this aspect is seen as the most essential in the offering but modern findings show that the overall customer satisfaction can be greater through other characters of the offering. (op. cit.)

2.2.1.2 Service

Tangible products often come with intangible ones, such as service. Service cannot be handled or touched and demands no need for transportation or storage. The service can be resold completing more than one offering and is what surrounds the products by salesmen, installers, or support personnel. Selling a product without service is today almost not possible since it can consist of everything from product support to purchase advice or product installation. (op. cit.)

2.2.1.3 Logistics

Availability and transportation of goods to fulfill customer needs may be a deal-breaker, especially if there is a harsh competitive climate at a specific market. Logistics consider answers to questions such as where, when and how a product should be handed over to the customer. Companies often sprung from a geographical placing have to adapt to their geographical markets whereas depending on product attributes the logistic solutions may be more or less advanced. An example of a logistic solution commonly offered is just-in-time delivery (JIT)

which aims to deliver the product exactly when the customer needs it and thereby eliminate the customer's need for costly storing. (op. cit.)

2.2.1.4 Information and consulting

Related to service characteristics the information and consulting rather considers the company's effort to understand customer problems and their part in solving these problems. The need for information and consulting may differ depending on market characteristics and customer knowledge. Complex or very expensive products may need more consulting while a cheap and simple product is sold just by being placed on a shelf. (op. cit.)

2.2.1.5 Pricing and cost

Pricing strategies are common and they have through history been explained by the effort and cost that has been put down while the creating the product. Modern strategies focus more on what the customer is willing to pay and what it is worth for the customer. The competitive climate is also strongly affecting prices. It is fundamental that direct and indirect costs are covered by the price to ensure that the company will remain economical sustainable. (op. cit.)

2.2.1.6 The offering summary

A product offering has to be considered as a whole since each included character affects the other. It is also important that the supplier does not see the offering as something static since it can change from customer to customer to fill each one's specific needs. Any customer differentiation has to be put in relation to any extra costs that might occur because of such adaptations. For a supplier to create the most profitable offering great knowledge of company resources and abilities is required. Good customer relationships are also considered important for sustainable development of supplied offerings. (op. cit.)

2.2.2 Purchasing - supply chain actors and interactions

Products such as glulam, which often are parts of bigger projects for the customer, have complex purchase processes. Stakeholders affecting the purchase might be many and Ford et al., (2006) classifies different roles in the purchase as:

- Buyers
- Influencers
- Gatekeepers
- Deciders

Buyers of glulam vary, depending on the specific offering, but can include private persons, builder merchants and big construction companies. Generally the smaller customers have their interests in simpler products for smaller constructions or complete housing constructions while larger actors may demand complete building solutions and greater volumes. What the glulam offering consists of is described in the previous theory chapter. (op. cit.)

Influencers have the possibility to affect choices of e.g. materials. They can be found internally and externally in many parts of the business. These can for example be found in development parts of an organization or as final users of a product. (op. cit.)

Gatekeepers regulate what information should reach the buyer. These are often purchasers or supplier contact people within the organizations. These actors play an important role in the decision making since they can allow or hinder any offering to reach the decider. (op. cit.)

Deciders can in similarity to many of the other roles consist of many different positions within an organization. It depends on organization structure and hierarchy and flows of information. It is not always possible to define one single decider since many actors can have a say in a specific project. (op. cit.)

By this description it can be understood that one position within a company or along a supply chain can have many of the roles involved in a purchase. Also it is possible for one person to for example be both a buyer and a gatekeeper. This together with the complexity in the construction sector described by Cigén (2003), among others, make the stakeholders in the final material selection many. This fact is important for suppliers and their marketers to be aware of since the decision of how to segment a market and select who to approach might be essential for success.

The building sector in Sweden is complex and the stakeholders are many (Nordstrand, 2008). To build is a question of permissions, dispenses and agreements, especially in urban areas with high demands on strategic planning. Therefore the process of building is often long from the first initiative to the time of a final construction. During this time many decisions should be made considering strategic, tactical and operative obstacles whereas the choice of material in construction is one major question. This choice, depending on the specific buyer, is often made early in the process since it is often a precondition for the rest of the production and allowance for starting the construction. (op. cit.) Stakeholders making these decisions are further on referred to as “decider”. The position of the deciders may vary significantly and some examples of common positions making the specification are (Cigén, 2003):

- Demanding (*Buyer, Influencers, Deciders*)
 - Developers
 - Property managers
- Designing (*Influencers, Gatekeepers Decider*)
 - Architects
 - Construction engineers
 - Project managers
 - Installation consultants
- Performing (*Influencer, Gatekeepers*)
 - Entrepreneurs
 - Craftsmen
- Controlling (*Influencers*)
 - Governmental

Demanders include developers and property managers, which consist of private persons, companies, organizations or authorities. This is a very heterogeneous group which, with an underlying demand for constructions, defines construction features (e.g. quality, price, design) and organizational arrangements such as project time and entrepreneurial schemes. Often the demander is responsible for providence of land and funding. (Nordstrand, 2008)

The designing group consists of architects, construction engineers, project managers and installation consultants. The architect's role in the construction supply chain mainly focuses on designs while the constructor accounts for dimensioning frame systems, walls and roofs. The installation consultant positions include installation of ventilation, plumbing and electricity etc..

Performers do like the name tells perform and administrate most of the construction production. This group often has a contract directly with the developer. (op. cit.)

Controllers, in this case governmental authorities and institutions, form the institutional playground on which present construction projects are established and completed. (op. cit.)

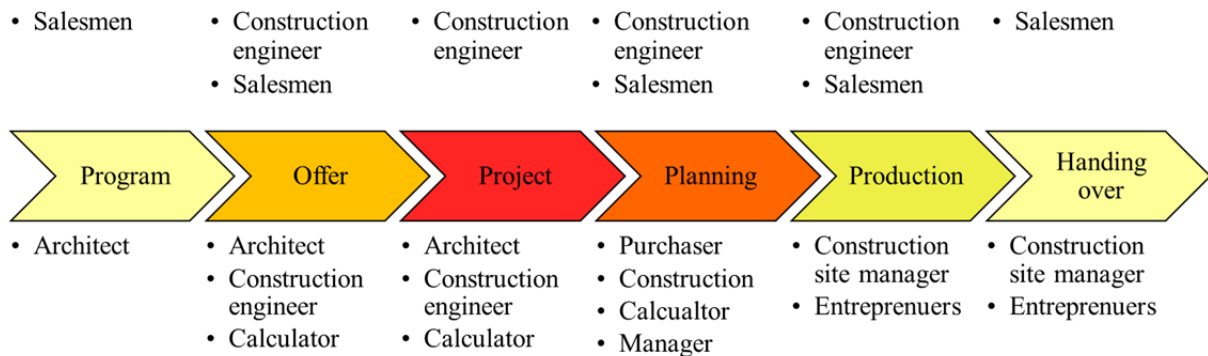
To merge the two theories the italic roles from Ford et al., (2006) in the above list is matched with the roles presented by Cigén (2003). Moreover does the choice of entrepreneurial schemes affect who among the different construction actors have more or less to say and can also affect the communication and building process over time. (op. cit.)

Persson (2000) nuances the picture of the respective stakeholder's by shedding light on the entrepreneurial schemes relation to their internal competences. Depending on the knowledge for a specific stakeholder different entrepreneurial schemes are likely to be used. This results in various influencers and deciders. Additionally the bargaining power of each individual stakeholder is of great importance. Summarized it can be said that a developer with high competence and great power takes many of the decisions in discussion with architects and constructors. If the internal resources of the developer are insufficient a project manager is likely to be contracted. This opens up the decision making for a larger number of actors and the architect and constructor might have greater influence. A third version is when an entrepreneur is contracted and takes responsibility for the whole project. This might limit the influence of architects and constructors in benefit for the entrepreneur. (op. cit.)

This difference among entrepreneurial schemes within the construction sector supply chains causes consequences for the material suppliers. Depending on which actor the material supplier choses to approach the form of wanted and needed information is most likely to differ (Ford et al., 2006).

Cigén (2003) illustrates the interaction between two value chains, the material value chain and the building process value chain. Along these two value chains the communication and interaction include different actors. Communication within each value chain is also fluent. Figure 4 is an illustration from Cigén (2003) which shows the building process' steps (arrows) and the included actors from each of the construction and material suppliers value chains at each step (bullets) of the process. The intensity of communication is indicated by the color of the boxes and aims to show that it is most intense in the project phase and the planning phase, before the production takes place.

Involved actors among glulam suppliers



Involved actors in the construction process

Figure 4. Actors included in the building process' different stages. Illustration based on Cigén (2003).

Within the two different supply chains there are different logics: one material logic (glulam products) and one construction logic (buildings etc.). At the production step in Figure 4 these logics are normally colliding and the material suppliers enter a stage of delivery and sale while the builder assembles different materials for the construction. The illustration in Figure 4 gives support to published traditional purchasing theory where it is suggested that communication often is most intense just before the production start and also includes many actors at the same time (Chopra and Meindl, 2012).

2.3 Theory syntheses

Following is a summary of presented theories and their adaption to the study purpose. A concentrated overview can be seen in Table 2.

2.3.1 Market environment and metrics

Initially, for part purpose one the market situation in which present glulam offerings compete will be studied based on macro environment in the adapted Information Environmental model (Figure 5). The market for the glulam producers can be categorized as "construction materials". This does, according to the Information environmental model, place other construction materials such as steel and concrete as competitors. By this definition the demand constitutes of construction activity and the supply is restricted to glulam, steel and concrete. Other macro environment factors are commodity prices and currency values. These are all ever-changing factors which motivate observation of time series and trends for increased understanding of present market situation. Theory on marketing metrics and customer segments form the frame for measuring industry successfulness through markets shares among selected segments.

The micro environment in Juslin and Hansens (2002) Information environment model was adapted to an industry rather than a single company, displayed in Figure 5. The light it shed on customers and competitors is of great importance for the purpose of this report and it is therefore preferred. This approach creates a frame for analyzing different actors' perceived influence on material selection, their perception of glulam competitive advantage and disadvantage as well as their purchasing patterns for present glulam offerings. Distribution will not be considered in the analyze model since the glulam producers have similar possibilities to serve the complete domestic market.

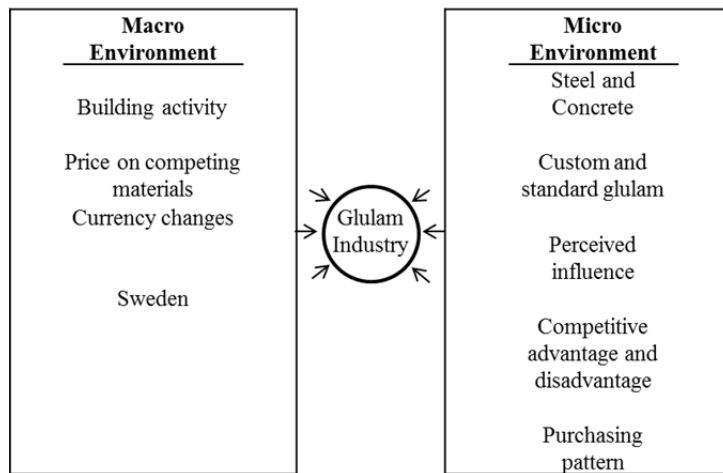


Figure 5. The Information environment model adapted to the research question and the study aim. Adopted from Juslin and Hansen (2002)

2.3.2 The offering and purchasing

Part purpose number two focuses on the industry as a whole, including a wide number of specific products. This makes theories on the offering not directly applicable and necessary to adapt to a more general approach. The ingoing parts in the offering (product, service, logistics, information/ consulting) vary between the different companies. This study embraces common industry offering features and the used theory therefore mainly emphasizes the product aspects (construction, environment, end user living environment etc.) of the offering. This since the differentiation between the companies to great extent is gained through the other ingoing parts of the offering.

Theory on purchasing is derived to identify influencers of material selection and their preferences concerning different construction materials. The positions of influencers in the building sector are put in relation to the purchasing process to identify their possibility to act and take decisions concerning material selection.

Theory of building sector actors' influence of material selection serve as a base for testing of the selected study populations self-estimated influence. It was also used as a frame for segmentation and to better understand the building sector supply chain.

Table 2. Summary of selected theories contribution to the purpose

Theory	Contribution to the study	Authors
Market environment and metrics	Frame for market analysis and to identify factors affecting the demand	Farris et al. 2010; Ford et al. 2006; Juslin and Hansen, 2002; Grant, 2013 Chopra and Meindl, 2012;
Purchasing	Identify supply chain interactions and influencers of material selection	Cigén, 2003; Ford et al. 2006; Nordstrand, 2008; Persson, 2000
The offering	Frame for describing glulam and identify competitive features	Ford et al. 2006

3 Method

3.1 Research approach

My five years of forestry master studies have included many aspects of forestry and its related markets. The wide perspective and the understanding of complexity that it has brought is something I bring with me in the research approach of this study. This reflects in the research approach which initially aims to create a general picture of the present situation and its emergence. It will from two angles enlighten the contemporary discourses concerning the present glulam market and its offerings. Differences among the two research approaches include the first part's macro character focusing on demand and other environmental factors whilst the second part focuses on different supply chain actors in a micro environment perspective. For this, the following research approach will be used.

Studies of reality, i.e. *empirical studies*, consider increased understanding for contemporary problems and situations and are common among many modern social scientists. An approach of empirical character aims to explain reality through observations and analyses. The methodology is not necessarily groundbreaking since information is not constant and tends to change over time. (Jacobsen, 2002)

Causality is the relation between two or more empirical phenomena where one depends on the other. Ideas of how different variables are correlated may be present but can be difficult to assure without systematic observations and analyses. The causality in this study concerns glulam demand on the Swedish market and any variables that might affect it. (op. cit.)

The chosen study approach takes a wide grip of the studied area. Through a wide approach a more general picture of the current situation was created. Jacobsen (2002) classifies the specificity of research approach through the number of units observed and the focus of the research. Here the number of units was large and it was a phenomenon rather than a context that was investigated. Therefore a more *extensive survey methodology* in combination with the macro-environment analysis was used. A narrower approach e.g. a case study, would probably have limited the research to exclude variables that might have affected the situation. (op. cit.)

Much of the previous research within this area (Fallgren, 2010; Färlin, 2009; Hugosson et al., 2008; Högsborn, 2007; Roos et al., 2010) has been of qualitative character taking base in interviews with a selected number of stakeholders. A qualitative method is suggested advantageous if deeper understanding of why things are like they are or if patterns are aimed to be understood. In contrast to the many previous studies the chosen method is of *quantitative* character, complementing the research area with an alternative approach (Jacobsen, 2002). The purpose of this report aims for a quantitative research approach to be used, but with an open touch. It can therefore be seen as a cross-sectional study using multiple methods to be able to describe the observed data as well as possible. The connection to the purpose is important also here (Trost, 2010) and it is suggested that a quantitative approach is suitable when questions concerning percentages or shares of a certain population attempts to be answered. If the main research question regards how many or how often, a quantitative method is also recommended. This is the case in this study which motivates a quantitative approach. The method is criticized for not taking specific opinions in consideration, possible leaving out important reasons explaining the observed situation. The complexity of the construction sector could have motivated a qualitative approach with focus on specific stakeholders which are likely to possess the wanted information. Thus, in accordance to Persson (2000) the entrepreneurial schemes highly influence which stakeholder might affect

the construction material. This fact gave through the quantitative approach a possibility to segment the respondents depending on their role in the construction sector and their self-estimated influence on material selection after data was sampled.

A *deductive* approach is characterized by the fact that research findings are organized by some theoretical framework. It includes theoretical axioms and hypotheses which are tested to be either false or true. In contradiction to an inductive approach which presents and interprets results not directed by any hypotheses. (Jacobsen, 2002) The selected area of research is wide and would have been overwhelming without any assumptions of what is affecting market fluctuations and theories for analyzing them. Data on factors which are likely to affect the glulam demand was compiled during the initial phase of the study and during the questionnaire survey a structured and selective approach was considered. The deductive approach is aligned with a quantitative approach since it demands systematic review of data and standardized tools for analyzing. (op. cit.)

The literature review and personal meetings with representatives from the glulam committee (Svenskt Limträ²³) indicated that there is a lack of knowledge and prevalent uncertainties present among today's glulam producers. Understanding of preferences and opinions on glulam present at the construction market wanted to be gained. The aim was to test existing assumptions of present glulam offerings wherefore it was possible to produce a standardized questionnaire. It included questions, exploring opinions and preferences through a number of alternatives rather than a narrative approach with open answers. This preferred *explorative approach* is aligned with a systematic review which is more permissive to standardize data sampling and make it possible to draw conclusions from statistical analyses derived from the collected data. (Jacobsen, 2002)

3.2 Selection of research approach

Summary of the used study approach is here presented:

- Empirical - Aim to describe how things are rather than why
- Causal - Assumptions made based on cause and effect
- Extensive - A wide understanding
- Quantitative - Focus on numbers, shares and statistical analyses
- Deductive - A preset idea of how things are to limit and focus the studied area
- Explorative - Enhance understanding through systematic research

This approach synthesizes in two methods for data and population sampling and following analysis. The first, focusing on the macro-environment and included factors affecting glulam demand through compilation of related secondary data of time series from 2003 to 2013. The second aims to get a grip of stakeholder influence on material selection and their opinions concerning present glulam offerings. This was made through a survey methodology with standardized questionnaires distributed at the construction fair Nordbygg 2014 in Stockholm. These methods are further on described here.

3.3 Method for data sampling

Data can be primary or secondary depending on if it is the researcher who has collected the data or if it has been done by someone else in advance. (Christensen, 2001) This study included both. Data was sampled in two steps which are hereon described. Usage of multiple data sources, known as a multivariate method, is common within the social sciences to cover

²³ Svenskt Limträ. Meeting 2014-03-20

various aspects of a certain research question. It is aligned with the explorative and deductive research approach and forms a base for further analytical considerations. (Befring, 1994)

When the research idea for this study was born a meeting was held with Chairman Mikael Eliasson²⁴ and Senior advisor Johan Fröbel²⁵ at Swedish Wood in Stockholm. During the meeting the current situation for the Swedish glulam industry and related problems were discussed. Lack of market information was a major obstacle which led to the presented study purpose. The meeting resulted in a list of market factors which would be interesting to analyze. The list has been edited in time since new factors have emerged and some have been found lacking relevance. This as a result of gained insight in the research question through study of previously published literature, meetings with industry representatives and scientist within the area of forest products marketing. The remaining factors are presented below.

3.3.1 Part 1 - Secondary data

The complexity of the construction sector and the wide approach of this study encouraged an initial review of available statistics to get a historic and a contemporary view of the market and its dynamics. Compilation of this secondary data aimed to account for the number of critical factors that might affect the glulam demand and by that enhance the focus of following data sampling.

For part purpose one, secondary data was exclusively used. Statistics on building related materials is richly produced in Sweden and the amount of data for this study had to be limited. The data was mined from databases of Statistics Sweden, Sverige Bygger AB and Swedish Wood (SCB, 2014a; Swedish Wood, 2014b; Sverige Bygger AB, 2014a). Statistics Sweden is an administrative agency with main task to produce communicating and statistical data for the public and private sector. Sverige Bygger AB is an information gathering company providing market information and analyses to customers along the construction value chain. Information on building details such as building start, entrepreneurial scheme, building costs and material selections are some of the demanded data. (Sverige Bygger AB, 2014b) According to Peter Åhs²⁶, marketing director at Sverige Bygger AB, its market coverage is the best available in Sweden today but an accurate estimate of total market share coverage is not possible to give. Data were:

- Cubic meters sold glulam, quarterly (Swedish Wood, 2014b)
- Square meters building allowance, quarterly ((SCB, 2014b)
 - Schools and Universities;
 - Culture, Entertainment and Sport
 - Industry and Storage
 - Single-family houses
 - Multi-family houses
- Import price index for metal frames and related products and production price index for metal frames and related products, concrete products for constructions and sawn and planed wood. Index 100 year 2005.
- SEK/EUR Exchange rates, quarterly (European Central Bank, 2014)
- Number and cost of construction projects, annually (Sverige Bygger AB, 2014a)
 - Building type (arenas, hotels, restaurants, schools etc.)

²⁴ Mikael Eliasson, Chairman Swedish Wood, pers. comm. 2014-01-13

²⁵ Johan Fröbel, Senior Advisor Swedish Wood, pers. comm. 2014-01-13

²⁶ Peter Åhs, Marknadschef Sverige Bygger AB. E-mail 2014-03-19

- Building sort (new and additional)
- Total project costs (SEK)

Data was retained both monthly and quarterly. It was aggregated quarterly to limit any obstacles with lagging data. For example the municipality, which administrates building allowances, should within ten weeks of submitted application give permission or a preliminary decision to the applicant. (Boverket, 2014a) This time lag, between retained building allowance application and the start of construction indirectly including purchase of any possible construction material, motivated the aggregation even if it might have influenced the possibility to identify details in monthly variations. The segmentation was made by the different data suppliers and the units for further analysis were therefore already given. Data on farmer buildings, which is an important segment for the glulam industry, were not gained since they are not demanding building allowances (Boverket, 2014b).

Sales data of glulam gained from Swedish Wood consists of monthly reports from the four glulam producers and is segmented into custom and standard glulam.

The segmentation of construction types is commonly used for describing building activity in a nation and also matches with the major customer segments of the commodity suppliers. Building activity is the area of approved building allowance per housing type and quarter. It represents the gross area and includes the total area surrounded by walls. (SCB, 2014b)

The choice of import price index (IMPI) for steel was made after talking to Bengt Henricson²⁷ at Prognoscentret AB who indicated that steel used in Swedish constructions is both domestic and imported from other parts of Europe. As long as quality demands are met the imported steel would often be preferred because of a lower price. The other commodity price indexes represent domestic production for the domestic market.

The data from Sverige Bygger AB included a list of specific building projects planned between the years 2003 and 2013. It contained the total number of projects which could likely include glulam. The annual construction cost per construction type was also included in the list. (Sverige Bygger AB, 2014c)

3.3.2 Part 2 - Primary data

Data was sampled through a quantitative approach in a questionnaire survey compiling primary data. The questions were standardized for the selected population and based on theories presented in the previous chapter. The structure of the sampling methodology was well defined, meaning that the questions were specified to regard only one specific area and factors that might be connected to it. (Trost, 2007)

Hultåker writes in Enkätboken (Trost, 2007) about the importance of creating well balanced questionnaires depending on the media used for sampling. In difference to posted questionnaires, where the respondents generally have more time, the situation on a fair (see population sampling method in next chapter) or similar arrangement is more time limited wherefore the number of questions had to be few to get as many respondents as possible. This also motivates multiple choice questions which could be easier to answer and demand less writing compared to open ones.

²⁷ Bengt Henricson, Marknadsanalytiker Prognoscentret AB. pers. comm. 2014-01-27

Survey questionnaire

The survey questionnaires concerning glulam and associated activities took base in theories on the offering and general theoretical frame concerning construction sector alignments. To create the specific questions previously published master theses and scientific papers (Fallgren, 2010; Färlin, 2009; Hugosson et al., 2008; Högsborn, 2007; Roos et al., 2010) with similar aims but different methodologies were studied. Knowledge of the underlying theory concerning the building process was necessary for better understanding and analysis.

Attitudes and preferences are diffuse variables which can consist of prejudices, experiences, and feelings. They are in such way of both behavioral and emotional character also affected by motivation. It can be defined as an individual's way of reacting to objects and actions in its surroundings and will form its behavior regardless of its rationality. The questionnaire intended to quantify attitudes toward construction materials and therefore aligned with related considerations. A main concern when sampling data as such is that it has to be possible and relevant to compile answers in comparable groups. It is of importance that the questions asked are easy to interpret and that the different alternatives make sense to the respondents considering his or her experience, knowledge and general verbal skills. (Befring, 1994)

Apart from basic information about the respondent such as age, geography and profession the questionnaires included two blocks of box questions. The first block included questions with scaled answers stretching from, for example "not agree" to "totally agree" on a five numbered scale, also known as the Likert-scale. (Befring, 1994) By guidance of presented purchasing and construction sector theory the respondents were here asked questions on their own possibility to take part in the selection of construction material and material supplier. The second block took base in theories on the offering and compared glulam with steel and concrete. The complete questionnaire can be viewed in Appendix I and a summary of predefined offering parameters can be viewed in Table 3.

Table 3. Summary of included parameters in the questionnaire concerning the offering

The offering attribute	Included parameters
Construction technique	Span, height, speed, personnel demand, formability, fire-resistance, possible module-constructions, durability schemes
Construction safety	Number of dangerous moments, dry and quiet work environment
Environmental friendliness	Limits green gas emissions, renewable material, recyclable, local commodities, good life cycle characteristics
Costs	For material, construction, operation and living, maintenance, demolition
Experience for end user	Looks, scent, natural, feeling, acoustics, design possibilities
Living environment for end user	Moisture resistance, fire-resistance, sound-isolation, warmth-isolation, life-time
Personal experiences	Experience, knowledge, customer demand for materials, supplier availability of materials

Each main parameter included three to eight sub-parameters which together represent the total offering. The aim was to, as objectively as possible, indifferent of experience among the respondents, gain insight in stakeholders' preferences, perceptions and knowledge of present glulam offerings. By selecting these parameters an attempt to cover the main aspects of a construction material was made. However, some might argue that these pre-defined parameters give an incomplete and miss-guiding comparison especially if aspects

advantageous for other materials than glulam have been left out from the questionnaire. If such has happened it was unintentional and most likely due to lack of understanding in construction techniques. The questionnaire was firstly tested and reviewed by researchers at the institution for forest products and managers at Swedish Wood. Answers were retained directly since the respondents took their time in the booth and handed in the questionnaires after 5-10 minutes. The language of the questionnaire was Swedish and answers were interpreted and translated by the author before presenting the results and analysis in this report.

3.4 Population sampling method

3.4.1 Part 1

The population representing the secondary data gathered during the study consisted of the total Swedish construction sector. The large coverage was gained by using the nationwide statistical database SCB. Moreover Sverige Bygger AB, previously presented, contributed with a nuanced picture of construction projects numbers and costs. Swedish Wood contributed with glulam sales numbers which covered the total number of producers in Sweden.

3.4.2 Part 2

Descriptions of the Swedish building sector gives a complex picture of who are influencing and deciding what material should be used in the building process' different stages. To cover the possibilities of finding new influencers and deciders in the building sector no specific group of building sector actors were selected. Instead the population sampling was made controlled and randomly (Trost, 2007) among visitors at Nordbygg 2014 in Stockholm, the 3-4th of April. The randomness was derived by asking and handing out questionnaires to people visiting the booth of Swedish Wood and also people who were taking a break in a neighboring café. Hence, the total population consists of fair visitors with many different backgrounds and roles in the building process.

In the nature of quantitative research methods, a large sample size is necessary for conclusions to be drawn. The number in itself creates a greater coverage of market characteristics and increases the validity. This in difference to a qualitative approach, where the selection of the right actors has to be made very carefully to get a correct population opinion, the outreach to a greater population number also decreases the influence of any possible outliers. (Jacobsen, 2002)

Defining the population as visitors of the construction fair was advantageous for fulfillment of the purpose and to increase validity and reliability. The total number of fair visitors were $N = 52\,500$ but the number of people entering the booth of Swedish Wood (n) were unknown. The actual number of respondents (n_2) was after two days at the construction fair, 64.

Assumptions of the population sample were needed to correctly analyze and draw conclusions. Preferably an assumption that respondents represent a random sample of actors within the Swedish construction sector would have been done. This was not statistically possible since the fair was located in Stockholm and also limited to four days. Moreover the randomness can be questioned since fair visitors might be more interested in new solutions and more eager to gain insight in new materials and solutions than the average construction sector stakeholder. The fair lasted in total four days, of which data was collected during two. Preferably all four days would have been included to enlarge the number of respondents. This could not be managed due to time restrictions in the study schedule and last minute

configurations of the survey questionnaire. Despite these factors the population sample was the best available.

3.5 Statistical analyze method

3.5.1 Part 1 - Analysis of secondary data

Multivariate regression analyses were used to identify correlation between glulam demand, construction activity, commodity prices and currency changes. Regression analyses were made for example Total glulam sales (Y) (m³) year *i* versus total building allowance (X) (m²) year *i* with the constant *k* and coefficient β , giving following relation:

$$Y_i = k + \beta X_i$$

Total annual building allowances were initially put in relation to total glulam sales to identify any correlation. The data indicated strong seasonal variation which motivated categorical predictors to be used, creating separate constants for each quarter. Regression analyses were also made based on specific construction types. Graphs were also produced for further analyses to identify outliers and changes over time.

Concerning data from Sverige Bygger AB, representing the building activity related to glulam, it included projects of such types most likely demanding custom glulam rather than standard glulam. With this assumption the sales number of custom glulam was tested against the annual number of construction projects and their respective costs.

The software used for the analyses was Minitab. It enables descriptive statistics and regression analyses in a simple way, fitting the purpose of this study. It was also the program the researcher was most familiar with since previous studies. Moreover, Minitab Help has reduced the number of obstacles by conducting correct analyses and interpreting results.

3.5.2 Part 2 - Analysis of primary data

Perceived influence

The method for analysis largely depends on the size of the samples. To increase the number of respondents in each subgroup an aggregation was made according to Cigén (2003). Demanding, Designing and Performing were the groups used and excluded was the Controlling group since no respondents represented this group.

Analyses of answers derived through the Likert-scale demands assumptions. The intervals between the different alternatives 1-5 are alike but do not give an exact value to each answer. Instead it tells that the respondents with higher points agree more with the presented statement than the ones with lower points. The respondents' answers were summed per question and stakeholder group to identify any differences in perceived influence and attitudes. Since the number of respondents per subgroup was relatively small (5-30 people) no normal distribution was present. This motivated further segmentation of the answers, ending with two final groups, Not likely to agree (1-3) and Likely to agree (4-5). By using Fisher's exact test for analyzing it was possible to produce p-values through usage of 2x2 contingency tables. In this way two subgroups at a time could be compared with each other to identify any significant differences in perceived influence. By doing this to all of the subgroup's, resulting in six tests per question, a rank of each subgroups perceived influence and attitudes could be produced. The statistical analysis resulted in few significant differences between the stakeholder groups so the answers were further analyzed graphically.

The software used for this analysis was GraphPad software's, Quickcalc. It is free online software for scientific calculations that can be used for different kinds of data sets which in this case was categorical data in a 2x2 contingency table. (GraphPad, 2014)

Glulam competitive advantage and disadvantage

The respondents were here summoned to one group to enable a chi-square distribution and statistics. They were for this part asked to pick the one material they perceived best regarding a specific parameter. Even so, many of the respondents had picked two alternatives which for the analyses had to be eliminated. Answers of that kind were considered as "no opinion" in the final data set. Each variable was covered by a number of questions and each variable's question can be viewed in the survey questionnaire in Appendix I. Chi-square test were derived for each parameter separately, including all sub-parameters, as well as for the total offering. For these analyses Minitab was used.

The answers were assumed to be chi-square distributed and the degrees of freedom were 63 for each variable. Chi-square cross tabulation tests were conducted since 2x2 factor tables were produced with construction material on one axis and a statement concerning construction material properties on the other. The raw data consisting of number of answers was analyzed.

Assumption of a chi-square distribution gives a null-hypothesis saying that no association exists between the variables. If, for example, the p-value for one chi-square statistic is lower than selected alpha-level (in this case 0.05) the null-hypothesis can be rejected, stating that there is existing association between the variables and that people not have answered randomly. Moreover each variable's contribution to the chi-square statistic indicates how much the retained answers diverge from the assumed number of answers. A high number of the chi-square distribution of one specific variable indicates that the number is either higher or lower than expected which indirectly states if respondents consider this answer alternative more or less relevant.

3.6 Ethical considerations

A strive for impartiality despite the host organization's interest in wood was gained through the author's awareness and aim to correctly describe the current market situation, regardless of any possible political, social or financial factors. Even so Swedish Wood was mentioned in the missive, the letter following the questionnaire. This might have affected the respondents to answer in favor for the glulam alternatives when handing out in the booth of Swedish Wood at the construction fair.

Each individual respondent had to select a category of respondent and it is not sure that they really felt like belonging to any of the alternatives. Therefore the "Other" category was created, covering any other respondents.

The questionnaires were anonymous and could not be traced back to any person. No register of the respondents was kept.

3.7 Reliability and validity

Reliability is a measure of how reliable a study is i.e. if the results are derived in a reliable way. One motive for high reliability in this study is a present awareness of the influential role of the author when sampling data. When approaching respondents at the fair and talking to people within the industry an advantage in knowledge of glulam in comparison to the other

materials has been present. This knowledge has been necessary for execution of the study and should not have affected the study outcome.

The distribution of the survey questionnaire was located in Swedish Wood's booth at the fair which is something that might have tilted the results in favor for glulam because of the respondent's self-initiated visit to a booth with focus on wood. Moreover it cannot be excluded that respondents thought of glulam specifically and not included regular wood in their considerations. On the other hand, it can be said that many of the respondents stated that they had both knowledge and experience of two or more materials, especially for the sub-group designers.

The standardized questionnaire used for part two generates high reliability since it can be reused for any other population. It was adapted to fit a wide range of actors within the construction sector and could gain insight about many different stakeholder groups. It included questions with short descriptions of each parameter in the offering comparison which left space for own interpretations. What was considered best regarding "construction height" or "construction span" for one respondent might not mean the same for another, mostly due to personal preferences and previous experiences. Distribution of the questionnaire within another context could therefore change the outcome.

Validity for the chosen quantitative research study approach and method is mainly derived from a large population sample covering a great share of the total population. This was partly gained through the wide approach to population sampling that was made possible at the construction fair. The generalizability is though fairly low for all segments since the number of respondents was low, especially for the segment Demanders. Larger subgroups could have enabled further analysis based on differences between specific stakeholder groups. A new population could have been approached but would have resulted in complications when summoning and interpreting the results. Instead as preferred this study could motivate further studies with a more focused approach towards a customer segment or a specific construction type. For the later analyses the aggregation to one large segment could be said to represent a more general picture of how visitors at the construction fair perceive present glulam offering in comparison to steel and concrete. Argument for lower validity could be the psychological aspect of perceptions and attitudes which easily could be affected by the surrounding environment, prejudices, interpretation of the questions and adaption of opinion to predefined answer alternatives.

4 Results and Analysis

4.1 Part 1 - Macro

4.1.1 Construction activity

The area of approved building allowances shows strong seasonal fluctuations. The trend of the last ten years is neutral but the annual building activity has varied around the mean level of 1.7 million square meters per quarter or 6.8 million square meters per year as showed in Figure 6.

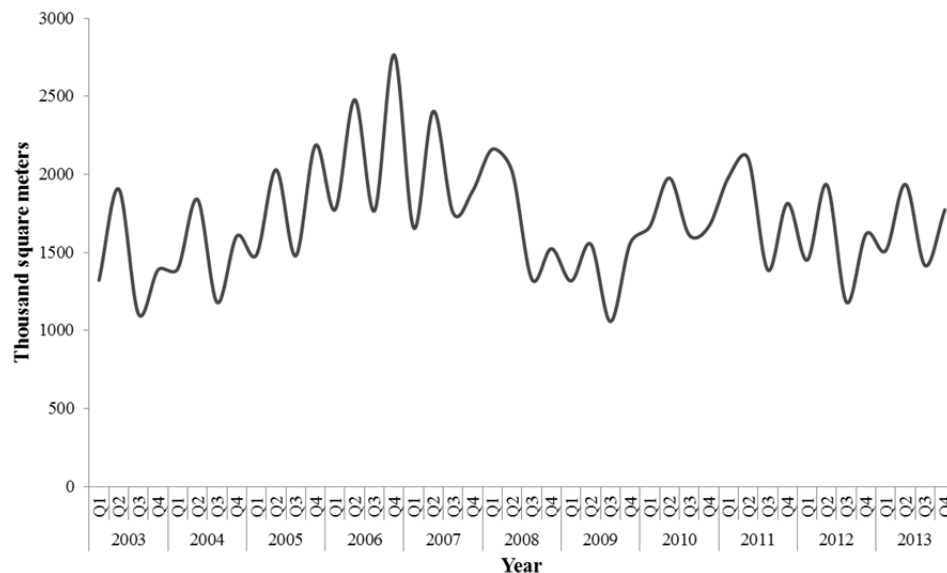


Figure 6. Thousand square meters of total building allowance (new productions, reconstructions and additional constructions) per quarter in Sweden from 2003-2013. (SCB, 2014b)

Its relation to the total glulam sales is shown in Figure 7. It indicates that the market share has remained and the competition against other construction materials has been sustained. The seasonal fluctuations are apparent also here and have increased since the beginning of 2008. An increasing trend for the total time period is apparent and is representing an increased market share for glulam.

A general regression analysis with the categorical predictors for quarter one to four (Q) verifies the seasonal changes and resulted in four different models with separate coefficients but with same relation to the total building. Y_i = Total glulam sales year i and X_i = Total building activity year i . These were:

$$Y_i = 6460(Q1); 10076(Q2); 10454(Q3); 8411(Q4) + 0.00293X_i$$

The model gave a degree of explanation R^2 -adjusted of 31 percent and significant p-values (0,001 and 0,046 respectively) for the constant and the building activity at the 95 percent confidence interval level. The residual plots and Durbin-Watson statistics of 0,388 indicate autocorrelation of the residuals which however is expected since time series data is not complete independent measurements.

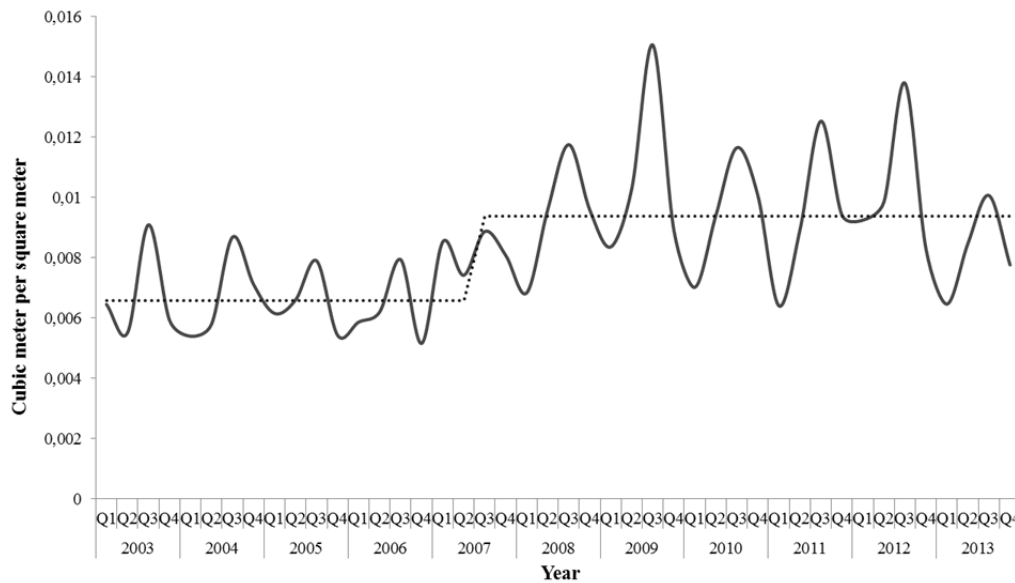


Figure 7. Volume of sold glulam per square meter of total building allowance for all house types in Sweden from 2003 to 2013. The dotted line indicates average from 2003-2007 and 2007-2013. (SCB, 2014b; Swedish Wood, 2014b)

In similarity to Figure 7, Figure 8 shows total glulam sales per year in relation to construction activity but here presented as annual total construction cost. The average is 0.73 cubic meter sold glulam per million SEK construction cost. Since 2003 the variation has been ± 15 percent with a slightly positive trend. Concerning the market share gain apparent in Figure 7 it roughly correlates. The recent years' dip is more real here than for the building allowance area. An explanation could be increased total building costs resulting in a lower share paid for construction materials.

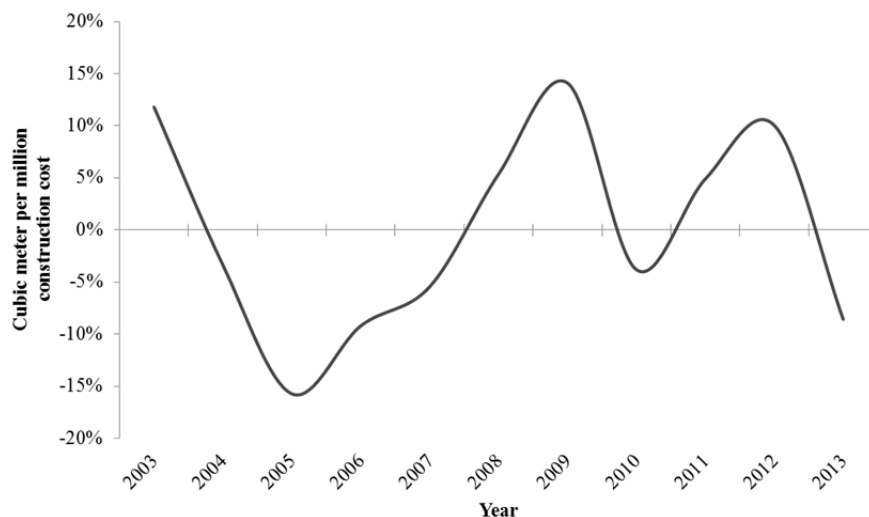


Figure 8 Market share indicator represented by cubic meter sold glulam per million SEK total construction cost. (Swedish Wood, 2014b; Sverige Bygger AB, 2014c)

The composition of the total construction activity has changed over time. Figure 8 shows respective construction type's share of total area building allowance per year. It indicates an increased share of multi-family houses and a lowered share of single-family houses. The area of industry/storage, store and office constructions have remained relatively unchanged as well as culture/sport/entertainment which is another important segment for the glulam industry.

Construction types of great importance for the glulam industry are among others presented in Figure 9. For custom glulam these are multi-family houses, industry/storage, store, office and culture/entertainment/sport. For standard glulam the main segments are single-family houses and vacation homes. (Svenskt limträ²⁸) Regression analysis for custom glulam dependence on each specific construction type resulted in high p-values and low degree of explanation (R^2 -adj=22.5 percent) indicating low correlation between area of building allowance and volume sold glulam. Explanations could be that glulam has been used in different construction types during different times to keep the offset high even when building activity among traditional glulam customer segments has lowered. One specific change of such could be the increased number of multi-story houses that has been built recent years.

The composition of the total building activity has during the past ten years changed. Interesting is that the share of industry and storage buildings increased in 2007 which could be one of the explanations to increased glulam market share in relation to total building activity. Traditionally it is the most important segment for the glulam industry and the share of such building has since then not lowered which further could motivate retained glulam market share.

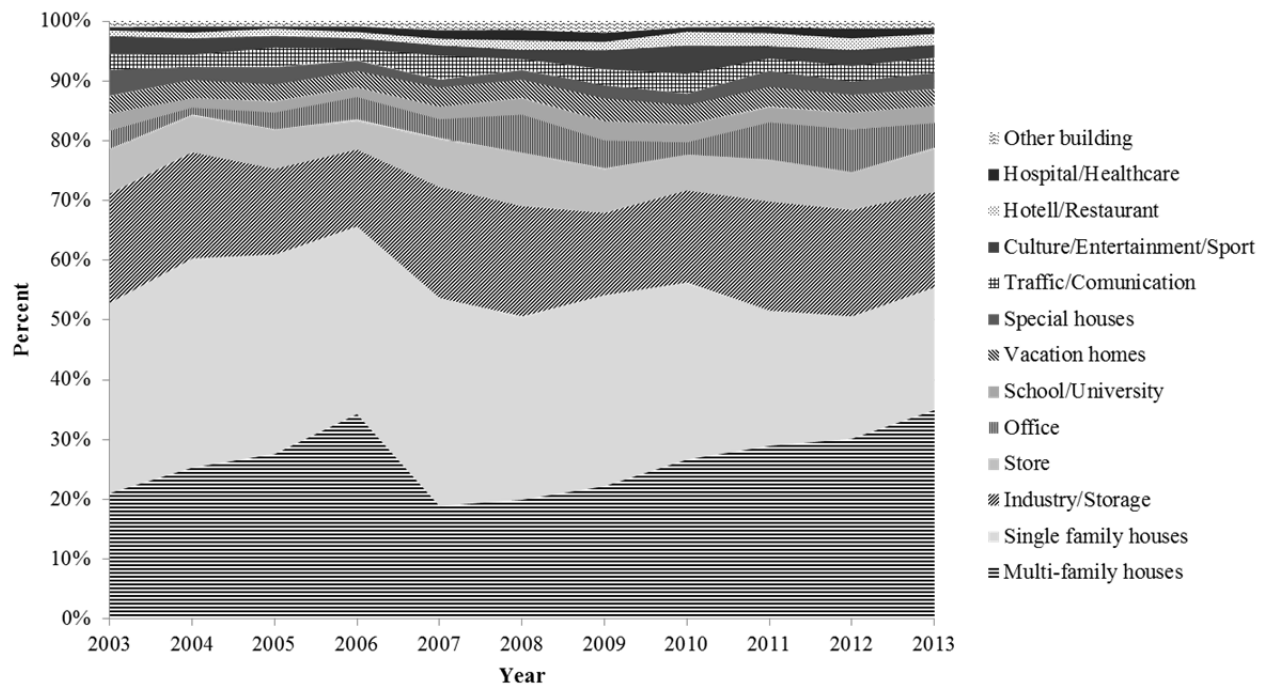


Figure 9. Square meters of building allowance in Sweden from 2003-2013 divided by construction type shares of total. (SCB, 2014b)

Within the industry the market concentration is very high with only four producers of glulam. This small number of actors gives each individual company's actions great impact on the macro data presented in Figure 7. The changes in market share and volumes of sales could therefore be explained by one specific actor's strategic changes rather than by an overall change in competitive climate.

²⁸ Svenskt Limträ. Meeting 2014-03-20

4.1.2 Construction costs

The last eleven years the average number of construction projects of each type per year is illustrated in Figure 10. Over time the number of projects has increased from approximately 5000 per year until today's 7700. The greatest increase can be seen in the number of storage constructions which in 2013 stood for 42 percent of the total number of projects.

The average costs for the same projects are displayed in Figure 11. As can be seen, multi-family houses have through history been the most expensive projects with an average cost of approximately 50 million SEK. The average cost of a multi-family building has increased from 41 million in 2003 to 54 million in 2013. Presented costs are total costs including everything concerning the construction project which for bridges for example could be, ground preparations and roads etc.(Åhs²⁹) Presented costs should therefore not be taken directly but rather in relation to each other.

Observation of extremes in Figure 10 and 11 could motivate two strategies for the glulam industry. Either to focus on a large number of small projects, such as storage and industry buildings or instead focus on a fewer number but instead expensive and therefore larger projects. Awareness of these differences should be considered vital for successful business.

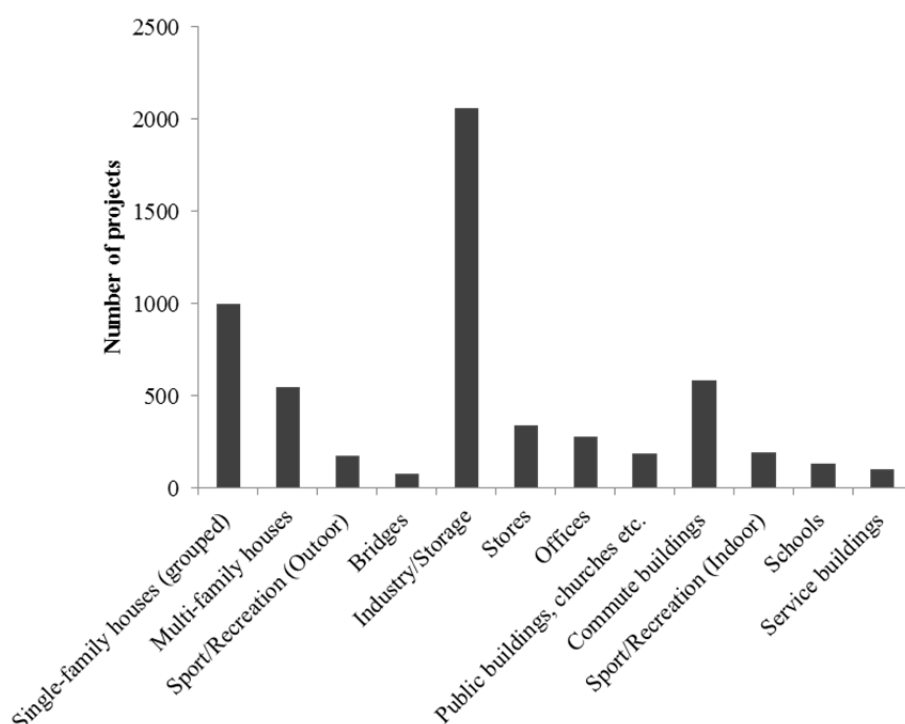


Figure 10. Average number of projects per construction type and year from 2003 to 2013. (Sverige Bygger AB, 2014c)

²⁹ Peter Åhs, Marknadschef Sverige Bygger AB. E-mail 2014-05-27

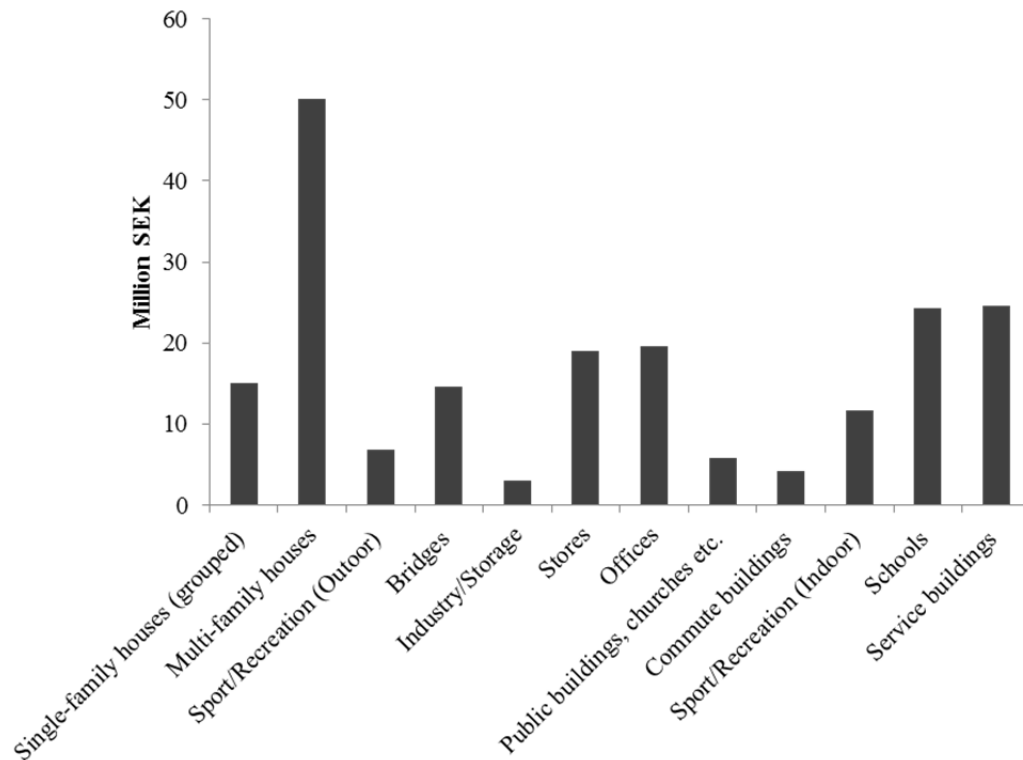


Figure 11. Average cost in million SEK per project and construction type from 2003 to 2013. (Sverige Bygger AB, 2014c)

4.1.3 Commodity prices

Figure 13 shows that the IMPI for metal frames and related parts has increased rapidly in comparison to the other construction materials the last number of years. Domestic steel and concrete have had a similar price development as sawn and planed wood. Notable is that the wood price index presented not includes glulam. This might be beneficial for wood in the comparison since variations in production costs and glue costs are excluded from the data. Interesting is that the observed peaks in wood production price index (PPI) correlates with the peaks in glulam sales. The causality is likely not very high since approximately 16 million cubic meters of sawn wood is produced in Sweden annually (Skogsstyrelsen, 2013) and only approximately 100 000 cubic meters of glulam is produced. With a commodity utilization of approximately 50 percent only 1 percent of the produced sawn wood is used for glulam production. More reasonable is that the presented wood price index reflects the global economy since Swedish sawn wood to a great extent is exported globally. One related finding is that the margins and the profitability for the Swedish glulam producers could vary more than for other construction material producers, given fixed glulam sale prices. Especially in comparison to international glulam producers with a sawn wood industry with lower export volumes.

The correlation between total glulam sales and PPI for sawn and planed wood relates to macro environment factors of supply and demand. Another observation that can be made is that the PPI for sawn and planed wood in 2012 went below similar index for concrete products and related parts for the first time during the observed time span.

One of the explanations to an increased and since then remained market share of glulam in 2007 could be the increased prices for imported metal frames. Hypotheses of a threshold price

giving glulam a competitive edge concerning price if imported metal frames exceed a specific level might be relevant.

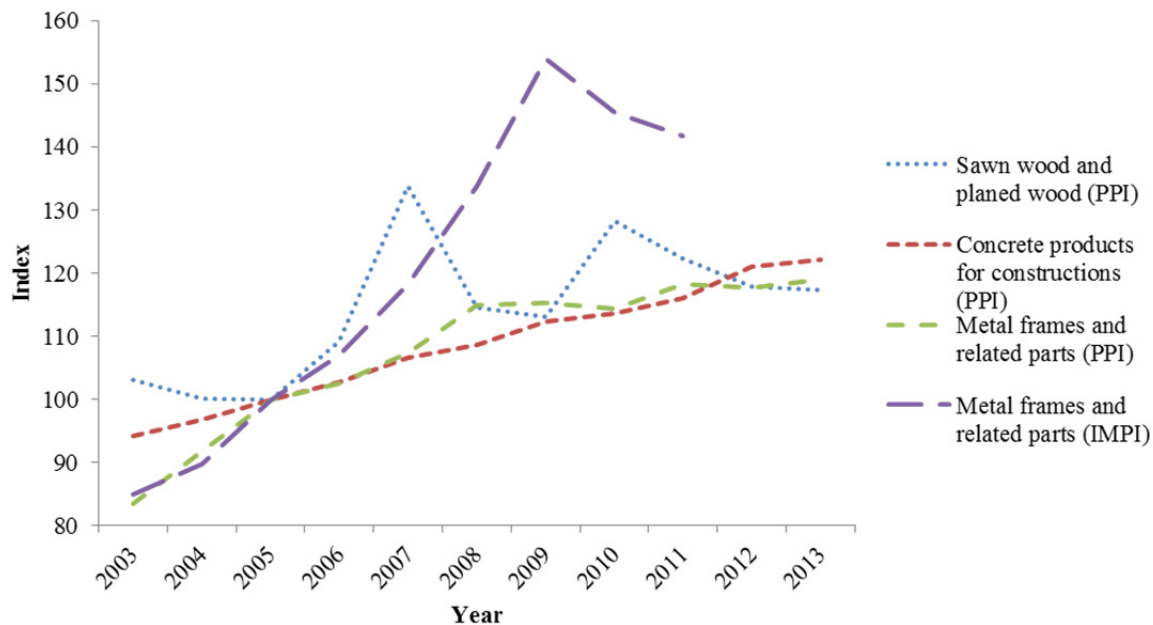


Figure 12. Production Price Index (PPI) for sawn and planed wood, concrete products for constructions and metal frames and related parts and Import Price Index (IMPI) for Metal frames and related parts from 2003 to 2013. Index 100 = 2005. (SCB, 2014c, 2014d)

Costs for commodities are often high for the wood processing industries, motivating focus on cost-effective production and high product flows. Also the fixed costs for sawmills are often high. These two factors together promote high production capacity utilization. As table 1 shows, the capacity utilization for the respective actors has the recent two years been between 35 and 100 percent and 60-70 percent for the industry as a whole. Moreover could higher wood prices motivate two production strategies. Either an increment of production volumes and product flows with lower margins or increased value adding through further processed products to increase the margins. Glulam could be an example of the latter.

4.1.4 Currency changes

A low valued SEK lowers the costs for buyers of exported glulam volumes from the Swedish suppliers. During times when the SEK is valued high increased profitability for Swedish producers can be gained on domestic market or markets where currencies fluctuate in similarity to the SEK. Europe is the most important international market for the Swedish glulam producers (Cederlöf³⁰; Lindberg³¹; Lundström³²; Åhlén³³) As can be seen in Figure 14 the EUR/SEK relation has changed over time, changing the conditions for international business. Given this development and presented hypothesis, the sales to Europe between 2007 and 2010 would have increased leading to either, increased utilization of available production capacity or lowered volumes sold on the Swedish market. From a currency perspective the importance of the Swedish market would have increased for the industry since 2010 until today. The causality is though relatively weak for this macro scale analysis since other aspects

³⁰ Leif Cederlöf, Product Manager Setra Trävaror AB. E-mail 2014-04-23

³¹ Mikael Lindberg, CEO Martinsons Byggsystem AB. E-mail 2014-05-07

³² Anders Lundström, CEO Glulam of Sweden AB. E-mail 2014-04-15

³³ Johan Åhlén, CEO Moelven Töreboda AB. E-mail 2014-04-28

such as lowered building activity in Europe in general due to harsh financial climate could be one other major reason for changed trade patterns.

The volume sold in Sweden did increase along with the lowering value of the SEK and since data was not gained for total sales including exports any further analysis was not possible. It is instead likely to believe that Figure 10 better represents the greater macro economical fluctuations in Europe, including Sweden, defending the increased volumes also sold in Sweden during the all-time high years 2007 and 2008 illustrated in Figure 2. Moreover a high valued SEK makes it more profitable for international glulam producers to export to Sweden, wherefore the competition on the Swedish market might have toughened in recent years. Glulam import volumes have been eliminated from this study since the toll number for glulam also includes other sawn wood products.

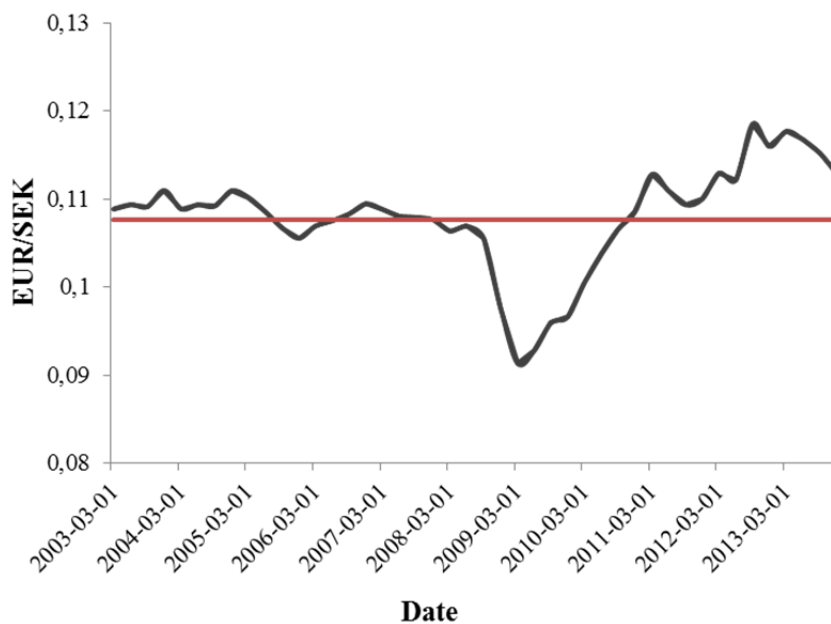


Figure 13. Currency value EUR-SEK from 2003 to 2014 with displayed average for the same period.(European Central Bank, 2014)

4.2 Part 2 - Micro

The answering population consisted of $n = 64$ people representing 9 main positions within the building sector. These were 4 developers, 1 property managers, 17 architects, 9 construction engineers, 4 planners, 8 entrepreneurs, 7 craftsmen and 14 others. In the group “others” there were 4 project managers and 1 purchaser of which a new subgroup was established. The remaining “others” ($n = 9$) not covered by the predefined groups held positions such as builder merchants, installation consultants, construction teachers or were from countries not connected to the study. Of the population 23 percent were from Götaland, 55 percent from Svealand, 16 percent from Norrland and 6 percent from Finland/Åland. 83 percent were men and 17 percent women and the average age was 44-53 years old. 40 percent of the respondents normally worked with projects valued between 1 and 10 million SEK. 30 percent of them normally worked with projects greater than 10 million SEK and 18 percent with project valued below 1 million. The respondents answered that they had knowledge concerning all materials that was asked for. An exception was the performing group which considered themselves having better knowledge about glulam and lacking knowledge of steel constructions. Also the respondents mentioned that they had knowledge about other construction materials such as wood and aluminum. The respondents worked with various construction types. Between 15-30

respondents worked with single and multi-family houses, Schools/ Universities, Culture/Sport/Entertainment, Industry/Storage and Offices/Stores. Fewer than five respondents worked with bridges and agricultural buildings.

The respondents were segmented into Demanding, Designing, Performing and Others. The number of respondents differed among the groups with only 5 in demanding and 30 in designing. Therefore the following analyses are made based on share of respective segment for a more fair comparison.

Of the respondents 42 percent had during the past year used glulam and would also the upcoming year use glulam within their organization. 31 percent had not used glulam and would not either during the upcoming year use glulam within their organization. 6 percent had not bought or did not know if their organization had bought glulam but would buy glulam the upcoming year. The remaining 23 percent did not know, would not buy or did not give an answer to the statement. This gives support to previously published literature (Bysheim and Nyrud, 2009) that purchase of wood and as in this case glulam is based on previous experiences.

4.2.1 Perceived influence

A Fisher's exact test analysis indicated no main differences among the customer groups in their perceived influence and decision power in the material selection. Exceptions, indicating significant differences at 95 % confidence interval level, were identified between Demander's and Designer's perceived possibility to decide material in constructions projects ($p\text{-value} = 0,0177$), indicating greater perceived decision power for the Demander's. Also between Designers and Performers the perceived influence and decision possibility of supplier selection showed significant differences with $p\text{-values}$ of 0.0181 and 0.0163 respectively, this with a greater score and influence for the performers.

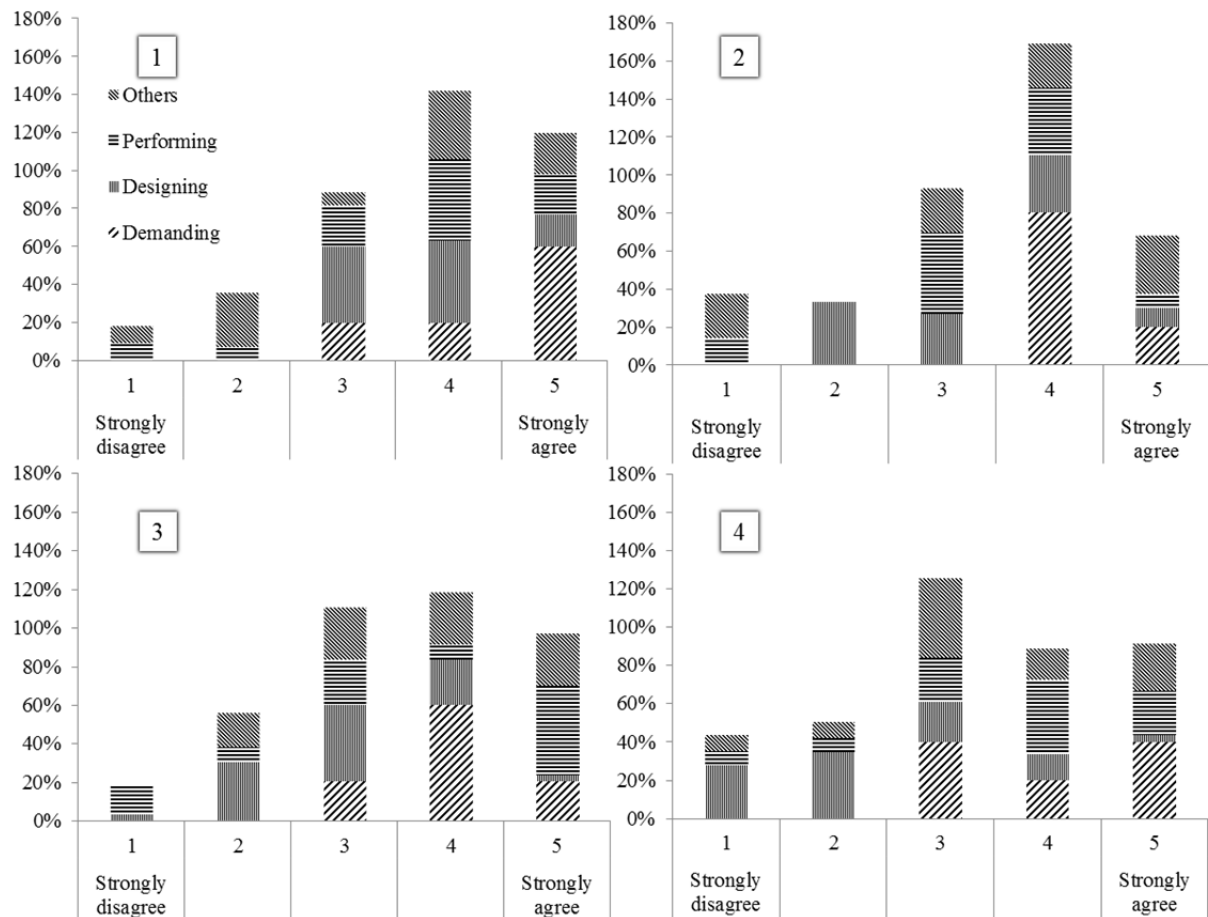


Figure 14. Respondent's answers to statements: 1. I influence the material used in projects I am involved in; 2. I decide which material to be used in projects I am involved in; 3. I affect which suppliers to be used in projects I am involved in; 4. I decide which suppliers to be used in projects I am involved in. Numbers are presented as share of answers per sub-group. Each pattern summons to hundred percent.

Demanders considered themselves influencing and deciding which material to be used in their projects mostly among the respondent. A majority of the designers considered themselves influencing material selection to some extent, but not totally. Concerning the other two groups and for the designers' decision possibilities no distinguishable differences could be seen. Some respondents considered their influence and decision possibilities as high, while some did not think they had any saying at all (Figure 15). This could be explained by the great heterogeneity within each customer group. Other explanations could be that respondents work under different entrepreneurial schemes. The entrepreneurial schemes were not an area of question which limits the possibility to increase the understanding of how actors within the construction process influence the material selection. For more significant differences segmentation could have been based on another parameter, for example entrepreneurial schemes or size of company.

The construction material used can be related to the suppliers of material. Also concerning them, the Demanders thought of their own influence as high. The Performing group did consider themselves, influencing and deciding which supplier to be used to a greater extent than concerning the material itself. The Designers considered their own influence and deciding possibilities as strongly limited concerning which supplier to be used.

A question was also asked if they were looking for new suppliers to solve existing problems. A majority of the respondents stated that they are actively looking for new suppliers to solve

existing problems. This was something that was more obvious among respondents except Demanders. The answers indicate that there is a possibility to affect purchase patterns which could make non buyers of glulam buy in the future.

In relation to the supply chain interaction model (Figure 4) the result can be interpreted. An early interaction is likely to reach demanders and designers which perceived themselves as the ones with greatest influence on material selection. Concerning the material suppliers the performing group could be important to interact with. This could eventually be more important for standard glulam than for custom glulam since standard often is sold through builder merchants.

4.2.2 Competitive advantage and disadvantage

To enable statistical analysis the subgroups were here gathered in one, representing the total number of respondents ($n=64$). Attitudes concerning glulam, steel and concrete and their perceived advantages and disadvantages are hereon presented by each parameter specifically (see Figure 15 for an overview). According to the respondents glulam has greatest competitive advantage when it comes to the environmental factors and the experience for the end users.

Chi-square test indicates that more respondents than expected thought of steel as the best material considering construction span and height. Also more than expected considered concrete as the most fire-resistant material. Fewer than expected considered steel as fire-resistant. Concerning glulam fewer than expected considered it to be best regarding construction height and durability classifications. Notably is that a great share of the respondents had no opinion of this.

The answers for construction safety follow a chi-square distribution quite well and the statistics indicate that respondents consider wood as a more quiet material to work with than other materials. A large number of answers with "no opinion" can indicate that respondents are not working hands on with construction or assembly.

The environmental argument shows outstanding result for glulam in comparison to the other materials. Chi-square p-value is 0,397 so the probability for a similar result on another population is not as likely as for the other variables. Other observations than glulam's great advantage was that the respondents found steel environmentally friendly because of the possibility to recycle it.

A great share of respondents had no opinion about costs of materials. Concrete was even so considered cheapest concerning maintenance costs, where glulam was perceived most expensive. Glulam constructions were considered cheapest to demolish.

The respondents' opinions about end user perception show advantage for glulam concerning most variables. For concrete, most advantage was found in the acoustics and steel's advantage was found in the possibility to design.

Living environment for the end user showed quite equal responses for concrete and glulam except for the variable warmth-isolation where glulam was perceived much better. Notably is that a great share of the respondents had no opinion of this.

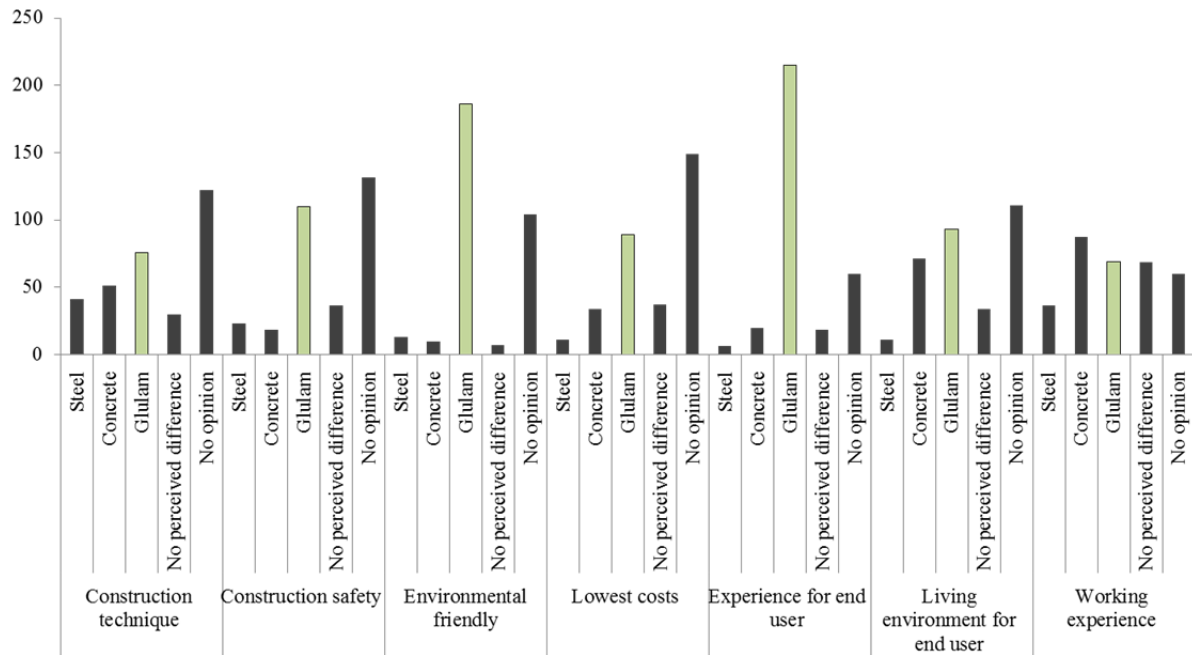


Figure 15. Number of respondents per material category leveraged so that each ingoing parameter represent an equal value. Data consists of answers to the question which material is best considering each parameter respectively.

It was a large share of the respondents that did not have an opinion about the presented factors. A large number of answers representing “no opinion” could correspond to complicated questions or a questionnaire with too wide approach in relation to the respondents’ knowledge and experience. Least opinions had the respondents considering costs of material but also concerning construction technique and safety. Chi-square statistics indicated that answers and displayed differences in material advantages and disadvantages were not retained randomly.

Assuming that the ingoing parameters are enough to explain each main variable correctly and that these together represent a fair picture of the total construction material offering an over-all chi-square test was conducted with the following results. Glulam was perceived best concerning the environmental aspect and the experience for end users. Steel had its greatest advantage concerning construction technique but was for the other variables considered less good. Concrete also had its greatest advantage in construction technique but in addition to steel it was perceived good also concerning the living environment for end users.

5 Discussion

5.1 Method discussion

The quantitative method contributed to a developed understanding of present market situation and its history. It included a large number of respondents, leveraging any extreme opinions and preferences which could have been present with fewer respondents. The number could preferably have been more but can in accordance to limitations in time and room be seen as satisfactory. This mainly deductive approach has focused my findings and limited the analyses to the selected factors. Assuming that relevant factors initially were identified the market analysis covers a wide perspective of factors closely related to glulam sales. Other possible explanations were considered as well as obstacles considering limitations of validity of the research findings.

The first part, including secondary data, aimed to identify correlations between related macro environment factors and glulam sales to understand market dynamics. The ingoing parameters in the analysis were mostly institutional data (Statistics Sweden and European Central Bank) but also data provided by private organizations (Sverige Bygger AB and Swedish Wood). Together this data diversifies the picture of Sweden's building activity and its relation to glulam sales. Other factors that might have an effect on the analysis could be housing prices, labor force salaries and institutional restrictions. Such, and other possible aspects, have deliberately been excluded from the analysis with purpose to focus the result to measurable relations closely related to construction material sales. Possibly, the number of housing starts could additionally have been used, which though would have limited the analyses to single- and multi-family houses.

For the time-series analyses the quarterly data increased the level of details and enabled greater insight in market fluctuations. Presented regression model for total glulam sales indicates that sales still exist if the construction activity is zero. This is not very likely and it can be assumed that the model is more accurate when the relation between construction activity and glulam sales is close to average. Tests for lagging data were derived and eliminated biases related to such.

The second part's controlled and random method for population sampling had it pros. It covered a wide number of different actors, enabling the possibility to create subgroups depending on their role and perception. The way of distributing the questionnaire was also advantageous, resulting in a high response rate in relation to the time effort. The researcher's control over the population sampling could also have limited the number of unsuitable respondents and thereby increased the reliability.

For chi-square analyses of the questionnaire responses assumptions of lacking multicollinearity was made. This is the assumption of observations not to be correlated. For the answers retained in the booth of Swedish Wood some correlation between the different answers occurred. Some groups of people from the same company or with the same professions answered the questionnaire and sometimes discussed questions that occurred. This happened for just a few number of respondents wherefore no further considerations was made.

5.2 Recommendations and comparison to previous studies

With a sustained area of building allowances and related construction activity an approach to new customers is likely needed to increase market shares. Such approach could further be

motivated by the fact that previous buyers of glulam tend to buy again. As also suggested by Fallgren (2010) a market share gain is most likely to occur by approaching new customer groups which are not contemporary buying glulam. Additionally, the fact that a great share of previous buyers of glulam intended to buy glulam in the future gives support that increased usage of wood is derived from experiences (Bysheim and Nyrud, 2009). It has to be remembered that market share in itself should not be a main goal but rather a result of profitable business for each and every of the four glulam producers.

In accordance to previous studies Jakobsson and Söderström (2009) costs and functionality are of greatest importance when it comes to selection of construction material and structural systems. As the results show glulam is considered competitive within these areas but it is not the materials' main strengths. Development of present offering to be more cost competitive and to increase the knowledge of how to use the material the best way is likely to increase sales. It is however easier said than done since a great share of the total cost is derived from commodities and fixed costs within the industries.

This study indicates that there are few actual disadvantages with modern glulam offerings. Competitive advantage might be gained by addressing advantages on a wider arena to get the public awareness creating a greater demand for wooden constructions. The data from Sverige Bygger indicates that the annual number of storage and industry projects is great in comparison to other types of buildings. This is a traditionally important market segment for glulam products which should result in many business opportunities for the glulam suppliers. Not as many but instead more expensive, are the constructions of multi-family houses which could be another important segment to approach. Especially when looking at the recent year's increment of building allowance area related to the construction type.

The complex interaction patterns within the construction sector demand extensive information of how to approach different actors depending on their level of knowledge and information. Therefore could an action of great interest for the glulam producers be to review the way they interact with the respective actors along the value chain. For business related to the public sector, so called innovative procurement should be of great interest. Concerning the construction sector the aim for innovative procurement is to create energy efficient construction solution for more sustainable communities. Established networks with such aim should create business opportunities for the glulam producers, even with already existing products. (Vinnova, 2014)

Concerning the stakeholders perceived influence on material selection this study give support to Roos et al. (2010) which questions the architects' power to influence and decide which material to be used. Also the role of the developer seems to be underestimated since few of previous publications have investigated their role concerning material selection. Their influence and decision power is according to this study of great importance.

The awareness of the positive environmental aspects of glulam seemed to have reached the market. This does not necessary increase the demand since buyers tend to focus on cost minimization. (Fallgren, 2010; Gold and Rubik, 2009; Jakobsson and Söderström, 2009) This study does though show that construction sector actors are not very aware of costs, or consider glulam as a cheaper alternative in all aspects other than maintenance costs. Increased efforts to promote the glulam benefits could therefore motivate decision makers and influencers to consider and select glulam as construction material.

6 Conclusions and recommendations

6.1 Part 1

- Domestic glulam market shares increased in 2007 and have since then remained the same. Explanations could be increased steel import prices and increased share of industry and storage constructions. Contemporary EUR/SEK valuation could also have increased focus on the domestic market.
- Given that the construction activity increases market share has to be gained through new customers and segments.
- Strategic decisions among the glulam suppliers could be made focusing on either, large number of projects or fewer high value projects.

6.2 Part 2

- Results indicate that demanders i.e. developers and property managers consider themselves able to decide which material to use. Designers, i.e. architects, construction engineers and project managers consider themselves influential regarding material selection.
- Previous buyers of glulam intend to buy glulam again, previous non-buyers do not.
- Perceptions of the glulam offering's competitive advantages in comparison to steel and concrete are environmental aspects and end user experience.
- Perceptions of the glulam offering's competitive disadvantage in comparison to steel and concrete is construction technique and for concrete specifically also living environment for end user.

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Appendices

Appendix 1.

Enkätundersökning Byggnadsmaterial



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Hej, och tack för att du tar dig tid att genomföra denna enkätundersökning!

Undersökningen är en del av ett examensarbete på Jägmästarprogrammet i Uppsala och genomförs på uppdrag av Svenskt Trä. Den har för avsikt att undersöka inställningen till olika byggnadsmaterial hos olika aktörer inom den svenska byggbranschen.

Eftersom att du är en av dessa ber jag dig svara på samtliga frågor och noga överväga dina svar för att bidra till ett så bra resultat som möjligt.

1. Födelseår

19_____.

2. Är du

☐ Man eller ☐ Kvinna

3. I vilket landsdel verkar du?

☐ Götaland ☐ Svealand ☐ Norrland

4. I vilken yrkesroll besöker du den här mässan?

Fler än ett alternativ är möjliga

- | | |
|---|---------------------------------------|
| <input type="checkbox"/> Arkitekt | <input type="checkbox"/> Bygghandlare |
| <input type="checkbox"/> Konstruktör | <input type="checkbox"/> Byggherre |
| <input type="checkbox"/> Byggnadsentreprenör | <input type="checkbox"/> Student |
| <input type="checkbox"/> Hantverkare | <input type="checkbox"/> Övrig |
| <input type="checkbox"/> Kommunalt anställd | Om övrig. Vad? |
| <input type="checkbox"/> Fastighetsförvaltare | _____ |

5. Vilken typ av byggnationer arbetar du vanligtvis med?

Flera än ett alternativ är möjliga

- ☐ Småhus ☐ Jordbruksbyggnader och Stall

- ☐ Flerbostadshus ☐ Affärs-, och Kontorslokaler
☐ Skolor och Universitet ☐ Broar
☐ Kultur-, Underhållning-, och ☐ Övrig
 Sportanläggning
☐ Industri och Lager Om övrig, vad?

6. Hur väl stämmer följande påståenden för dig i din yrkesroll:

	Stämmer inte 1	2	3	4	Stämmer helt 5
Jag <i>påverkar</i> vilket material som används i projekt jag är delaktig i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jag <i>fattar beslut</i> om vilket material som används i projekt jag är delaktig i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jag <i>påverkar</i> vilka leverantörer som används i projekt jag är delaktig i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jag <i>fattar beslut</i> om vilka leverantörer som används i projekt jag är delaktig i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jag letar aktivt efter nya leverantörer för att lösa befintliga problem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inom min organisation finns strategiska beslut om att öka användningen av förnybara material?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inom min organisation <i>kommer</i> vi under det kommande året <i>köpa</i> och <i>använda</i> limträ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inom min organisation har vi det senaste året <i>köpt</i> och <i>använt</i> limträ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Vilka material har du god kännedom om?

Flera än ett alternativ är möjliga

- ☐ Stål ☐ Betong ☐ Limträ ☐

Övrigt, vad?

8. Välj det av materialen som du anser vara bäst med avseende på följande parametrar:

Alternativen gäller de byggnationer som du vanligtvis jobbar med.

Byggnadsteknik	Stål	Betong	Limträ	Ingen upplevd skillnad	Ingen åsikt
Spännvidd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bygghöjd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Byggnadshastighet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Minst personalkrävande	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Formbarhet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brandsäkerhet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Möjlig prefabrikation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hållfasthetsklassificering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Konstruktionssäkerhet	Stål	Betong	Limträ	Ingen upplevd skillnad	Ingen åsikt
Andel farliga moment vid konstruktion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Torr arbetsplats	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tyst arbetsplats	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Miljövänlighet	Stål	Betong	Limträ	Ingen upplevd skillnad	Ingen åsikt
Binder kol och motverkar global uppvärmning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Förnybar råvara	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Återvinningsbart	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lokal råvara	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Goda livscykelegenskaper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lägst kostnader	Stål	Betong	Limträ	Ingen upplevd skillnad	Ingen åsikt
Materialkostnad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Konstruktionskostnad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drift- och boendekostnad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Underhållskostnad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rivningskostnad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Fortsättning. Välj det av materialen som du anser vara bäst med avseende på följande parametrar:

Alternativen gäller de byggnationer som du vanligtvis jobbar med.

Upplevelse för slutkund	Stål	Betong	Limträ	Ingen upplevd skillnad	Ingen åsikt
Utseende	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Naturlighet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Känsla "att ta på"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Akustik	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Designmöjlighet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Boendemiljö för slutkund	Stål	Betong	Limträ	Ingen upplevd skillnad	Ingen åsikt
Fuktbeständighet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brandsäkerhet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ljudisolering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Värmeisolering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Livslängd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Erfarenhet	Stål	Betong	Limträ	Ingen skillnad	Ingen åsikt
Jag har främst <i>erfarenhet</i> av att jobba med	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jag har främst <i>kunskap</i> för att jobba med	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mina kunder efterfrågar konstruktioner som främst inkluderar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mina befintliga leverantörer erbjuder främst	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Värdet (miljoner SEK) på de projekt jag vanligtvis arbetar med är:

- | | | |
|--------------------------------|--------------------------------|------------------------------------|
| <input type="checkbox"/> 0-0,5 | <input type="checkbox"/> 1-10 | <input type="checkbox"/> >50 |
| <input type="checkbox"/> 0,5-1 | <input type="checkbox"/> 10-50 | <input type="checkbox"/> Uppges ej |

Stort tack för din tid och ditt bidrag till undersökningen!

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Distribution
Sveriges lantbruksuniversitet
Institutionen för skogens produkter
Department of Forest Products
Box 7008
SE-750 07 Uppsala, Sweden
Tfn. +46 (0) 18 67 10 00
Fax: +46 (0) 18 67 34 90
E-mail: sprod@slu.se