DRVNA INDUSTRIJA

ZNANSTVENO STRUČNI ČASOPIS ZA PITANJA DRVNE TEHNOLOGIJE • ZAGREB • VOLUMEN 60 • BROJ 4
SCIENTIFIC AND PROFESSIONAL JOURNAL OF WOOD TECHNOLOGY • ZAGREB • VOLUME 60 • NUMBER 4

60

Pedocarpus spp.

4/09

UDK 630*8+674 CODEN: DRINAT ISSN 0012-6772

*UDK 630*8+674 Coden: Drinat ISSN 0012-6772*

DRVNA INDUSTRIJA

ZNANSTVENO-STRUČNI ČASOPIS ZA PITANJA DRVNE TEHNOLOGIJE
SCIENTIFIC AND PROFESSIONAL JOURNAL OF WOOD TECHNOLOGY

IZDAVAČ I UREDNIŠTVO
Publisher and Editor's Office
Šumarski fakultet Sveučilišta u Zagrebu
Faculty of Forestry, Zagreb University
10000 Zagreb, Svetošimunska 25
Hrvatska - Croatia
*Tel. (*385 1) 235 24 30*

SUIZDAVAČI
Co-Publishers
Exportdrvo d.d., Zagreb
Hrvatsko šumarsko društvo, Zagreb
Hrvatske šume d.o.o., Zagreb

OSNIVAČ
Founder
Institut za drvnoindustrijska istraživanja, Zagreb

DRVNA INDUSTRIJA *je časopis koji objavljuje znanstvene i stručne radove te ostale priloge iz cjelokupnog područja iskorištavanja šuma, istraživanja svojstava i primjene drva, mehaničke i kemijske prerade drva, svih proizvodnih grana te trgovine drvom i drvnim proizvodima.*

Časopis izlazi četiri puta u godini.

DRVNA INDUSTRIJA *contains research contributions and reviews covering the entire field of forest exploitation, wood properties and application, mechanical and chemical conversion and modification of wood, and all aspects of manufacturing and trade of wood and wood products.*

The journal is published quarterly.

OVAJ BROJ ČASOPISA SUFINANCIRA:

EXPORTDRVO

Sadržaj
Contents

NAKLADA (Circulation): *700 komada* · **ČASOPIS JE REFERIRAN U (Indexed in):** *CA search, CAB Abstracts, Compendex, DOAJ, EBSCO, Forestry abstracts, Forest products abstracts, Geobase, Paperchem*, SCOPUS · **PRILOGE** *treba slati na adresu Uredništva. Znanstveni i stručni članci se recenziraju. Rukopisi se ne vraćaju.* · **MANUSCRIPTS** *are to be submitted to the editor's office. Scientific and professional papers are reviewed. Manuscripts will not be returned.* · **KONTAKTI s uredništvom (Contacts with the Editor)** *e-mail: editordi@sumfak.hr* · **PRETPLATA (Subscription):** *godišnja pretplata (annual subscription) za sve pretplatnike* **55 EUR**. *Pretplata u Hrvatskoj za sve pretplatnike iznosi 300 kn, a za đake, studente i umirovljenike 100 kn, plativo na žiro račun 2360000 - 1101340148 s naznakom "Drvna industrija"* · **ČASOPIS SUFINANCIRA** *Ministarstvo znanosti, obrazovanja i športa Republike Hrvatske.* · **TISAK (Printed by)** *- DENONA d.o.o., Getaldićeva 1, Zagreb, tel. 01/2361777, fax. 01/2332753, E-mail: denona@denona.hr; URL: www.denona.hr* · **DESIGN** *Aljoša Brajdić* · **ČASOPIS JE DOSTUPAN NA INTERNETU**: *http://drvnaindustrija.sumfak.hr*

DRVNA INDUSTRIJA · Vol. 60, 4 · str. 195 - 264· zima 2009. · Zagreb
REDAKCIJA DOVRŠENA 1.12.2009.

IZVORNI ZNANSTVENI RADOVI
Original scientific papers **197-228**

ESTIMATION OF TECHNICAL EFFICIENCY IN PRODUCTION TECHNOLOGIES OF CZECH SAWMILLS
Procjena tehničke učinkovitosti proizvodnih tehnologija u češkim pilanama
Premysl Sedivka **197-207**

ESTIMATING THE EXTENT OF INFLUENCE OF TWO INTRINSIC FUELWOOD PROPERTIES ON ACCEPTANCE/ RETENTION OF SOME WOODY SPECIES IN AGROFORESTRY PRACTICES IN SOUTHWEST NIGERIA
Procjena veličine utjecaja dvaju bitnih svojstava ogrjevnog drva na primjenu nekih vrsta drva u agrošumarstvu jugozapadne Nigerije
Andrew A. Erakhrumen **209-218**

PERCEPTIONS & USE OF TERMITE RESISTANT TREATED WOOD PRODUCTS IN THE UNITED STATES. PART II: THE PERSPECTIVE OF HOME BUILDERS AND ARCHITECTS IN FORMOSAN SUBTERRANEAN TERMITE INFECTED STATES
Percepcija i uporaba drvnih proizvoda zaštićenih od termita. Dio II: Stajališta graditelja kuća i arhitekata u državama zaraženim podzemnim termitima iz porodice *Coptotermes*
Richard Vlosky, Tood Shupe, Qinglin Wu **219-228**

PRETHODNA PRIOPĆENJA
Preliminary papers **229-243**

EFFECT OF FEED SPEED AND WOOD SPECIES ON ROUGHNESS OF MACHINED SURFACE
Utjecaj posmične brzine i vrste drva na hrapavost obrađene površine
Nedim Škaljić, Ružica Beljo Lučić, Ankica Čavlović, Murčo Obućina ... **229-234**

OSIGURANJE IMOVINE KAO RIZIK U POSLOVANJU DRVNOG SEKTORA
Insurance of Assets as a Risk in Wood Sector
Mario Koprolčec, Krešimir Greger, Andreja Pirc, Maja Moro **235-243**

PREGLEDNI RAD
Review paper **245-251**

ZNANSTVENE METODE ODREĐIVANJA DRVNIH KONSTRUKCIJA KUTNIH SASTAVA
Scientific Methods for Determination of Wooden Corner Joint Designs
Silvana Prekrat, Nikola Španić **245-251**

KONFERENCIJE I SKUPOVI
Conferences and meetings **253-259**

SAJMOVI I IZLOŽE
Fairs and exhibitions **260-261**

UZ SLIKU S NASLOVNICE
Species on the cover **262**

Premysl Sedivka[1]

Estimation of Technical Efficiency in Production Technologies of Czech Sawmills

Procjena tehničke učinkovitosti proizvodnih tehnologija u češkim pilanama

Original scientific paper · Izvorni znanstveni rad
Received – prispjelo: 23. 7. 2009.
Accepted – prihvaćeno: 18. 11. 2009.
*UDK: 630*832.1; 674.093:004; 674.093:65.011.4*

ABSTRACT • *The main aim of this paper is to determine the influence of the type of adopted production technology on the technical efficiency of Czech sawmills, using one-year data of sawmills and applying a stochastic frontier production function model. Individual technical efficiencies have been obtained for small, medium and large sawmills, and their determinants have been estimated using a procedure proposed by Battese and Coelli (1995). The results support the hypothesis that sawmills in the sample failed to achieve full technical efficiency.*

Key words: *technical efficiency, frontier production function, wood-processing industry*

SAŽETAK • *Cilj provedenih istraživanja bio je utvrditi utjecaj primijenjene proizvodne tehnologije na tehničku učinkovitost u češkim pilanama. Korišteni su jednogodišnji podaci pilana na koje je primijenjen stohastički granični funkcijski model proizvodnje. Posebne vrijednosti tehničke učinkovitosti dobivene su za male, srednje i velike pilane, a utjecajni činitelji procijenjeni su primjenom postupka što su ga predložili Battese i Coelli (1995). Dobiveni su rezultati potvrdili hipotezu da istraživane pilane nisu u potpunosti tehnički učinkovite.*

Ključne riječi: *tehnička učinkovitost, granična proizvodna funkcija, industrijska prerada drva*

1 INTRODUCTION
1. UVOD

The impact of technological change on productivity has been seriously considered in economic literature, since the continuous improvement of new production technology has a considerable impact on the economic growth of businesses.

Despite the acknowledged importance of technological innovation and of technologies, which produce products giving a relatively high added value to productivity growth, during the research a number of empirical studies (Faria *et al*, 2005; Mallok, 2005; Faforullah, 1999) mentioned that the level of technical efficiency has failed, due to the adoption of a relatively old type of production technology, as well as due to ineffective use of inputs. These scientific studies demonstrate the importance of investing in new production technologies, which can either increase the value of production (Peschler, 1974; Saljé and Meyer, 1975) (more typical for medium-sized and large businesses) or increase the variability and flexibility of production (Faria *et al*, 2005; Mallok, 2005) (more typical for small businesses), depending on the branch of industry.

Variable productivity in woodworking processes can be explained by differences in the type of production technology adopted, in the efficiency of the production process, and in the business environment (e.g.

[1] Author is assistant at Department of Wood Processing, Faculty of Forestry and Wood Sciences, Prague, Czech Republic.
[1] Autor je asistent u Zavodu za obradu drva Fakulteta šumarstva i drvne tehnologije, Prag, Republika Češka.

statutory regulations) (Lesourne and Barré, 1991). By investigating productivity and efficiency as the two major types of concepts, this study presents new empirical evidence on the relationship between the process of innovation in productive technology (decrease in automation of the technology adopted) and productivity.

For investigating the effects, a given type of woodworking technology for cutting logs of small and medium-sized diameter will be used, due to the increasing value of manufactured timber under the current conditions of increasing softwood yields and the higher flexibility of sawing, attendance to growth of cutting speed, rate of feet, assessment of deformations affecting the log forms, increasing width of saw kerf (for instance by using profiling technology where a cutting optimization system uses stored lumber dimension data to determine the highest value cutting solution for maximum yield) (LINCK, 2008), by the cutting of large logs by bandsaw technology to increase the flexibility of current cutting schemes with thin saw kerfs (EWD, 2008).

To investigate the efficiency of sawmill sawing, a stochastic frontier production function is employed, where inefficiency is measured as the deviation of the sawmill's output from an idealized frontier function, computed for the whole woodworking industry. The efficiency of a production unit is determined by comparing the observed and optimal values of its outputs or inputs (Lovell, 1993). This study extends the literature that defines the performance of firms as a function of the state of technology and economic efficiency.

The objective of this study is twofold: First, it aims to provide measurements of the technical efficiency of Czech sawmills by determining the stochastic frontier production function for a time period before the start and implementation of the Operational Program of Industry and Innovations, 2007 – 2013, in the Czech Republic. Second, it aims to investigate the impact of the different types of production technologies adopted by sawmills on their own technical efficiency. It will investigate 16 types of production technologies (wrt. Table 1) accepted by Czech sawmills.

2 MATERIALS AND METHODS
2. MATERIJAL I METODE

2.1 Data
2.1. Podaci

The data used in this study are from the database of the Creditinfo Czech Republic, s.r.o. corporation. The database is called *„Company Monitoring“* and is used by the Ministry of Trade and Industry of the Czech Republic and the CzechInvest organization for the statistical investigation of industrial sectors (researched data have been chosen from a version to be published in September 2008). This database includes the full versions of *„Profit and Loss Account“* and *„Balance Sheet Budget“*, always done separately for each timber processing unit. From these sheets, 203 sawmills were randomly separated, for which complete cross-sectional data are available for the year 2006. Data in this database have been periodically updated ever since 1998. Data used in this study were updated in the database on September 1, 2008.

This study includes corporations having the status of corporate entity (e.g. Ltd., Inc. and others) and category according to the definition of the company's size by the *I. Injunction of the European Commission, No. 70/2001, digest 364/2004 Ministry of Trade and Industry*. Companies in the database were distributed into individual groups according to the attribution of OKEC numbers.

The businesses classifed into database according to the OKEC numbers were selected from the branch category OKEC 20.1 (Sawmill Companies) up to the year 2006.

The year 2006 was selected in consideration of the time period before implementation of the Operational Program of Industry and Innovations, 2007 – 2013, in the Czech Republic, to receive financial support to invest in new types of processing technologies. According to the *Account Rules No. 563/1991, part III, §21a,* corporations having the status of corporate entity should publish their *„Profit and Loss Account“* and *„Balance Sheet Budget“*. Furthermore, the database includes information about the characteristics of businesses, including corporate entity status, ownership, number of employees and a basic overview of property structure.

The following data, used in a probability estimate model for parameters of the stochastic frontier production function, were computed from the database: number of employees, direct costs, labour costs, cost of capital, indirect costs. Data associated with the value of soft round timber, value of hard round timber, type of technology adopted, amount of working shifts and yield of sawn wood were obtained through a questionaire by owners and managers of sawmill companies and from the companies' websites.

For gross value of capital, figures of fixed assets are used given in the database, which describe the value of land, buildings, machines, and equipment. Data on the gross value of capital for the eight businesses have to be calculated with regard to data from the preceding years 2005 and 2004, because these data are missing in the database. The number of employees directly reported in the database and by the two businesses has to be calculated with regard to data from the preceding years 2005 and 2004, because these numbers are missing in the database. For the gross value of production, figures of fixed assets are used given in the database, which describe the value of production and sold depreciation write-off property. However, the 11 businesses missing in the database have to be calculated with regard to data from the preceding years 2005 and 2004. All these variables are in logarithms. Figure 1 shows the percentage of adoption according to type of main production technology.

Figure 1 shows a higher incidence of adopting 1 Band Saw Machine (horizontal) (30.0 %), than a combination of 1 Band Saw Machine (horizontal) and 1 Edger Saw Machine (18.7 %) as a main production technology. This can be explained by the fact that these

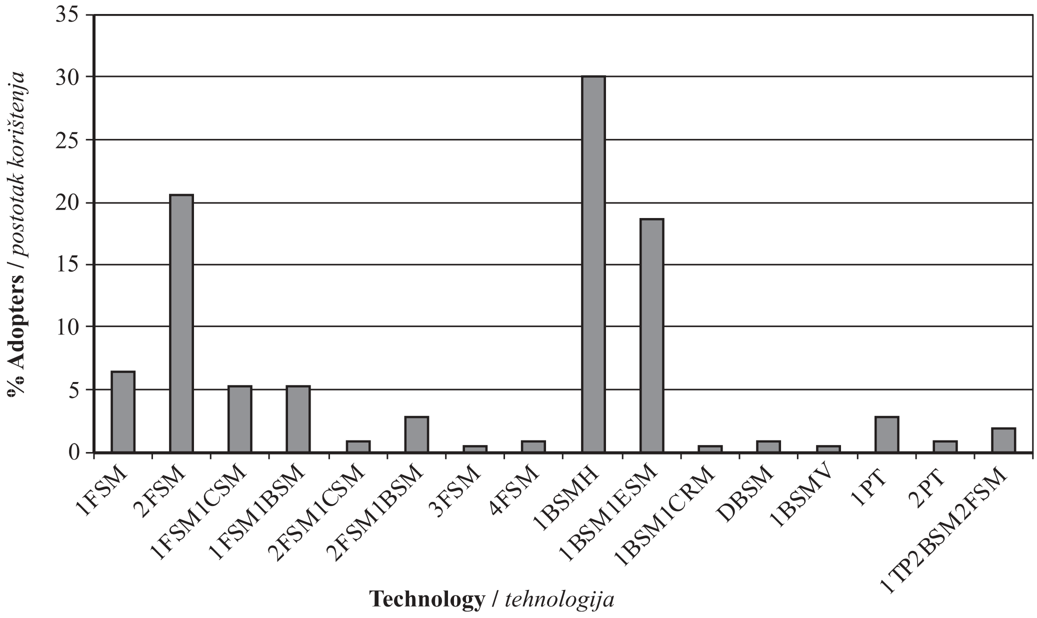


Figure 1 Adoption (%) according to type of technology (meaning of signification at *x*-axes is described in Table 1)
Slika 1. Postotak primjene određene vrste tehnologije (značenje oznaka na osi *x* navedeno je u tabl. 1)

technologies have an advantageous higher flexibility in sawing the inputs of round timber (possibilities of sawing a wide range of dimensions and diameter of round timber and the elimination of some log defects), variability of dimensions in the manufactured sawn wood, and at the same time a quick change of manufacturing programme, low capital costs of investment in the new type of technology, as well as low operating and service costs. Furthermore, Figure 1 shows a higher incidence of adopting the Double Frame Saw Machine (20.7 %), which can be explained by the fact that this type of wood processing technology has been used due to a historical tradition of using this type of production technology in the area of the Czech Republic.

Table 1 provides an overview of the contribution of production technology adopted by sawmills used in this study, and Table 2 provides values of descriptive statistics, which are used in econometric analysis.

Table 1 Type of adopted production technology
Tablica 1. Vrsta primijenjene proizvodne tehnologije

Technology / *Tehnologija*		**Signification** *Oznaka*	**Description** / *Opis*
1)	1 Frame Saw Machine *jedna pila jarmača*	1FSM	Two times cutting on one Frame Saw Machine. *Dvostruko piljenje na pili jarmači.*
2)	Double Frame Saw Machine *dvije pile jarmače*	2FSM	Second Frame Saw Machine cutting sawn-wood prism from the first Frame Saw Machine. *Druga pila jarmača raspiljuje prizmu dobivenu na prvoj jarmači.*
3)	Combination of 1 Frame Saw Machine and 1 Circular Re-saw Machine *kombinacija jedne pile jarmače i jedne kružne pile za raspiljivanje*	1FSM1CSM	Circular Re-saw Machine cutting sawn-wood prism from Frame Saw Machine. *Kružnom pilom raspiljuju se prizme dobivene na pili jarmači.*
4)	1 Frame Saw Machine + 1 Band Saw Machine (horizontal or vertical) *jedna pila jarmača i jedna tračna pila (horizontalna ili vertikalna)*	1FSM1BSM	Frame Saw Machines for cutting soft timber and Band Saw Machine for cutting of hard timber. *Pila jarmača za piljenje mekog drva i tračna pila za piljenje tvrdog drva.*
5)	Combination of 2 Frame Saw Machines and 1 Circular Re-saw Machine *kombinacija dviju pila jarmača i jedne kružne pile za raspiljivanje*	2FSM1CSM	Circular Re-saw Machine cutting sawn-wood prism from both Frame Machines. *Kružna pila raspiljuje prizme dobivene na jarmačama.*
6)	2 Frame Saw Machines + 1 Band Saw Machine (horizontal) *dvije pile jarmače i jedna tračna pila (horizontalna)*	2FSM1BSM	Frame Saw Machines for cutting soft timber and Band Saw Machine for cutting of hard timber. *Pile jarmače za piljenje mekog drva i tračna pila za piljenje tvrdog drva.*

Technology / *Tehnologija*		**Signification** *Oznaka*	**Description** / *Opis*
7)	3 Frame Saw Machines *tri pile jarmače*	3FSM	3 Frame Saw Machines are situated one after another. *Tri pile jarmače smještene jedna iza druge.*
8)	4 Frame Saw Machines *četiri pile jarmače*	4FSM	Frame Saw Machines are situated always two and two one after another. *Pile jarmače smještene su u parovima jedne iza drugih.*
9)	1 Band Saw Machine (horizontal) *jedna tračna pila*	1BSMH	Technology for flexible sawing. *Tehnologija za fleksibilno piljenje.*
10)	Combination of 1 Band Saw Machine (horizontal) and 1 Edger Saw Machine *kombinacija jedne tračne pile (horizontalne) i jednoga stroja za okrajčivanje*	1BSM1ESM	Technology for flexible sawing and edging of sawnwood. *Tehnologija za fleksibilno piljenje i okrajčivanje piljenica.*
11)	Combination of 1 Band Saw Machine and 1 Circular Re-saw Machine *kombinacija jedne tračne pile i jedne kružne pile za raspiljivanje*	1BSM1CRM	Circular Re-saw Machine cutting sawn-wood prism from Band Saw Machine. *Kružna pila raspiljuje prizme dobivene na tračnoj pili.*
12)	Double Band Saw Machine (horizontal) *dvostruka tračna pila (horizontalna)*	DBSM	Second Band Saw Machine cutting flexible sawnwood prism from the first Band Saw Machine. *Druga tračna pila raspiljuje prizme dobivene na prvoj tračnoj pili.*
13)	1 Band Saw Machine (vertical) *jedna tračna pila (vertikalna)*	1BSMV	Technology for flexible sawing. *Tehnologija za fleksibilno piljenje.*
14)	1 Profiling Technology *jedan stroj za profiliranje*	1PT	High efficiency cutting technology. *Visoko učinkovita tehnologija za piljenje.*
15)	2 Profiling Technologies *dva stroja za profiliranje*	2PT	High efficiency cutting technology. *Visoko učinkovita tehnologija za piljenje.*
16)	Combination of 1 Profiling Technology and 2 Band Saw Machines or 2 Frame Saw Machines *kombinacija jednog stroja za profiliranje i dviju tračnih pila ili dviju pila jarmača*	1TP2BSM2FSM	Second Band Saw Machines or Frame Saw Machines cutting sawn-wood prism produced from the High efficiency cutting technology. *Tračne pile ili pile jarmače raspiljuju prizmu dobivenu na stroju za profiliranje.*
17)	Finishing technology *tehnologija za završne obrade*		Technology for following woodworking (e.g. Milling machine, Edger saw, Pneumatic drill machine for nailed pallet, …). *Tehnologija za daljnju obradu piljenica (npr. blanjalica, pila za okrajčivanje, pneumatska bušilica i slično).*
18)	Drying chamber *sušionica*		Technology for drying of wood on required final wood moisture content. *Tehnologija za sušenje drva do željenoga konačnog sadržaja vode.*

Source: Computed from database "Company Monitoring Data" of CreditInfo Czech Republic, s.r.o., 2008.
Izvor: izračunano iz baze podataka "Company Monitoring Data" CreditInfo Czech Republic, s.r.o., 2008.

2.2 Methodology
2.2. Metodologija

The parametric stochastic frontier approach suggested by Battese and Coelli (1995) is used to estimate firm-level technical efficiency and investigate its determinants. This procedure was developed from Aiger (1977) and Meeusen and van den Broeck (1977) stochastic frontier model, which models the technical inefficiency effects in terms of other explanatory variables. The advantage of this model is that it gives a procedure for determining the values of companies' technical inefficiencies, and also estimates for comparing one to another.

The function of the translogarithmic production model is defined as:

$$ln(y_i) = \beta_0 + \beta_1 ln(x_{1i}) + \beta_2 ln(x_{2i}) + \beta_3 ln(x_{3i}) + \beta_4 ln(x_{4i}) + \beta_5 ln(x_{5i}) + \beta_6 ln(x_{6i}) + \beta_7 ln(x_{7i}) + (v_i - u_i)$$
$$i=1, \dots, N \qquad (1)$$

Where:

index i = represents i-th enterprise

Table 2 Descriptive statistics, Year 2006
Tablica 2. Deskriptivna statistika podataka za 2006. godinu

Variable / *Varijabla*	**Mean** *Srednja vrijednost*	**Standard deviation** *Standarna devijacija*	**Minimum** *Minimum*	**Maximum** *Maksimum*	**Number of observation** *Broj zapažanja*
Number of employees / *Broj zaposlenih*	28.103	68.569	1	598	203
Direct cost** / *Direktni troškovi*	52069.506	225200.745	0	2030980	203
Labour cost** / *Troškovi rada*	9347.656	27634.219	1.00	261664	203
Cost of capital** / *Investicijski troškovi*	5830.651	26320.497	2.08	246708	203
Indirect cost** / *Indirektni troškovi*	1500.088	5759.349	1.50	52332	203
Value of soft round timber *Vrijednost trupaca mekog drva*	19884.383	79753.645	0	756000	203
Value of hard round timber *Vrijednost trupaca tvrdog drva*	300.294	2376.302	0	31500	203
1) 1FSM	0.064	0.2454	0	1	203
2) 2FSM	0.207	0.4061	0	1	203
3) 1FSM1CSM	0.054	0.2269	0	1	203
4) 1FSM1BSM	0.054	0.2269	0	1	203
5) 2FSM1CSM	0.010	0.0990	0	1	203
6) 2FSM1BSM	0.030	0.1698	0	1	203
7) 3FSM	0.005	0.0702	0	1	203
8) 4FSM	0.010	0.0990	0	1	203
9) 1BSMH	0.300	0.4596	0	1	203
10) 1BSM1ESM	0.187	0.3910	0	1	203
11) 1BSM1CRM	0.005	0.0049	0	1	203
12) DBSM	0.010	0.0990	0	1	203
13) 1BSMV	0.005	0.0702	0	1	203
14) 1PT	0.030	0.1702	0	1	203
15) 2PT	0.010	0.0990	0	1	203
16) 1TP2BSM2FSM	0.020	0.1393	0	1	203
Finishing technology *Tehnologija završne obrade*	0.601	0.4909	0	1	203
Drying chamber / *Sušionica*	0.498	0.3012	0	1	203
Number of workshifts / *Broj smjena*	1.315	0.7241	0	4	203
Yield of sawnwood *Vrijednost piljenog drva*	9609.227	37961.560	7	360000	203

** Value in 1 000,00 CZK.
*** Vrijednost je u tisućama čeških kruna.*

y_i = total value of output of the i-th enterprise for i-th time period
$x_1, x_2 \ldots\ldots x_7$ are dummy variables representing different type of adopted production technology by each company
x_1 = Number of employees
x_2 = Direct cost
x_3 = Labour cost
x_4 = Cost of capital
x_5 = Indirect cost
x_6 = Value of soft round timber
x_7 = Value of hard round timber

$\beta_0, \beta_1 \ldots\ldots \beta_7$ are vectors of unknown parameters to be estimated
v_i = is random variables which are assumed to be iid. $N(0, \sigma_v^2)$ and independent of the u_i.
u_i = assumed to account for technical inefficiency in production with a half-normal distribution $|N(0, \sigma_U^2)|$.

All above mentioned variables are in logarithm.

The inefficiency model:

In this model, a half-normal distribution was expected using coefficients affecting the technical inefficiency of companies. These coefficients introduce information about the degree of use of the adopted production technology, degree of use of the technology for following woodworking (e.g. milling machine, edger saw, pneumaticdrill machine for nailed pallet, etc.), drying chamber, amount of working shifts and yield of sawn wood manufactured per year.

Also, a model for the effects of technical inefficiency for the type of cross-sectional data in the Cobb-Douglas production function, Equation 1, is then defined by:

$$u_i = \delta_0 + \delta_1 z_{1i} + \delta_2 z_{2i} + ... + \delta_{20} z_{20i} \quad (2)$$

Where:

u_i = is technical inefficiency of the i-th enterprise

$z_1, z_2 ...... z_{20}$ are dummy variables representing different type of adopted production technology by each company

z_1 = 1FSM (1 Frame Saw Machine)

z_2 = 2FSM (Double Frame Saw Machine)

z_3 = 1FSM1CSM (Combination of 1 Frame Saw Machine and 1 Circular Re-saw Machine)

z_4 = 1FSM1BSM (1 Frame Saw Machine + 1 Band Saw Machina)

z_5 = 2FSM1CSM (Combination of 2 Frame Saw Machines and 1 Circular Re-saw machine)

z_6 = 2FSM1BSM (2 Frame Saw Machines + 1 Band Saw Machina)

z_7 = 3FSM (3 Frame Saw Machines)

z_8 = 4FSM (4 Frame Saw Machines)

z_9 = 1BSMH (1 Band Saw Machine (horizontal))

z_{10} = 1BSM1ESM (Combination of 1 Band Saw Machine (horizontal) and 1 Edger Saw Machine)

z_{11} = 1BSM1CRM (Combination of 1 Band Saw Machine and 1 Circular Re-saw Machine)

z_{12} = DBSM (Double Band Saw Machine (horizontal))

z_{13} = 1BSMV (1 Band Saw Machine (vertical))

z_{14} = 1PT (1 Profiling Technology)

z_{15} = 2PT (2 Profiling Technologies)

z_{16} = 1TP2BSM2FSM (Combination of 1 Profiling Technology and 2 Band Saw Machines or 2 Frame Saw Machines)

z_{17} = Finishing technology (e.g. Milling machine, ...)

z_{18} = Drying chamber

z_{19} = Amount of workshifts

z_{20} = Yield of sawnwood

$\delta_0, \delta_1 ...... \delta_{21}$ are vectors of unknown parameters to be estimated

Parameters of descriptive statistics and estimates for parameters of the functional form of the Cobb-Douglas production model were estimated using the econometric programme LIMDEP (Green, 2002).

3 RESULTS AND DISCUSSION
3. REZULTATI I DISKUSIJA

The results of parameters from the Cobb-Douglas production model, given the specifications for technical efficiency defined by Equation 1, are presented in Table 3. The estimated sigma square (σ^2) of the Czech sawmills is 0.4472 (significant to 5 %). The value is significantly different from zero (Table 3). This indicates the good fit of the model and the correctness of the specified distributional assumption. The estimated gamma (γ) parameter of Czech sawmills is 0.81 and is significant at a 5 % level. This means that 81 % of variations in the output of sawmills among the Czech sawmills in this study are due to the differences in their technical efficiencies. This result approximates the findings of Faria, Fenn and Bruce (2005) – the result of the gamma parameter in this study is γ = 0.87.

The estimate for the Cobb-Douglas production model for γ is 0.81, which is consistent with the conclusion that the true γ-value is greater than zero.

The coefficients $\beta_0, \beta_1, ... \beta_7$, mentioned in Table 3 have a 5 % level of significance. The coefficient associated with the number of employees (β_1) indicates the positive contribution of a lower labour variable to the productivity of the sample of Czech sawmills in 2006.

3.1 Coefficients associated with the production costs
3.1. Koeficijenti povezani s troškovima proizvodnje

Coefficient of direct costs (β_2) indicates the negative contribution of the direct cost variable to productivity. This means that the ranking of coefficients, in order according to their impact on the productivity of the sample of Czech sawmills in 2006, is as follows: cost of capital (β_4), labour costs (β_3) and lastly indirect costs (β_5).

The coefficient associated with the production of soft round timber (β_6) is positive, while the coefficient associated with the production of hard round timber (β_7) is relatively strongly negative. This shows that the manufacture of hard round timber has a much higher impact on the efficiency of production in comparison with the manufacture of soft round timber. The main reason for this effect is perhaps the higher added-value of sawn hardwood production not designated for building construction, but rather for cabinet making, joinery products, wooden sleepers and parquet products. Sawmills focused on hardwood production usually adopted the band saw, finishing technology (e.g. milling machine, edger saw) and drying chamber.

3.2 Technical efficiency analysis of Czech sawmills
3.2. Analiza tehničke učinkovitosti čeških pilana

Finally, estimating the Cobb-Douglas production frontier function allows for a prediction of the mean of technical efficiency (TE) of sawmills in the sample. Table 4 shows that the mean efficiency is 0.6552, meaning that Czech sawmills could theoretically improve their productivity by 34.48 % with the same quantity of inputs. Figure 2 illustrates the distribution of the estimated individual technical efficiencies. The estimation of technical efficiency differs substantially among the companies, ranging between a minimum of 29.68 % and a maximum of 85.95 %. Out of 203 companies, approximately 82.76 % have an efficiency rate between the decile range of 60 % and 80 %.

The above-mentioned Table 5 shows the distribution of mean values of technical efficiencies according

Table 3 Maximum likelihood estimates for parameters of stochastic frontier production function (Year 2006)
Tablica 3. Procjena maksimalne vjerojatnosti za parametre stohastičke granične funkcije proizvodnje (2006. godina)

Variable / *Varijabla*	**Description** *Opis*	**Parameter** *Parametar*	**Coefficient** *Koeficijent*	**Standard-error** *Standardna pogreška*
General model (Production function) / *Općeniti model (proizvodna funkcija)*				
Constant / *Konstanta*		β_0*	2.0962	0.9537
Number of employees / *Broj zaposlenih*	x_{1i}	β_1*	0.0602	0.0406
Direct cost / *Direktni troškovi*	x_{2i}	β_2*	-0.0024	0.0002
Labour cost / *Troškovi rada*	x_{3i}	β_3*	0.3109	0.0246
Cost of capital / *Investicijski troškovi*	x_{4i}	β_4*	0.2949	0.0293
Indirect cost / *Indirektni troškovi*	x_{5i}	β_5*	0.4503	0.0273
Value of soft round timber *Vrijednost trupaca mekog drva*	x_{6i}	β_6*	0.0010	0.0009
Value of hard round timber *Vrijednost trupaca tvrdog drva*	x_{7i}	β_7*	-0.1130	0.1018
Inefficiency model / *Model neučinkovitosti*				
Constant / *Konstanta*		δ_0	0.6202	0.1152
1FSM	z_1	δ_1	-0.0520	0.0142
2FSM	z_2	δ_2	-0.0173	0.0014
1FSM1CSM	z_3	δ_3	-0.0281	0.0191
1FSM1BSM	z_4	δ_4	-0.0677	0.0394
2FSM1CSM	z_5	δ_5	0.1115	0.1082
2FSM1BSM	z_6	δ_6	-0.0248	0.0156
3FSM	z_7	δ_7	0.2292	0.1809
4FSM	z_8	δ_8	-0.1284	0.1026
1BSMH	z_9	δ_9	-0.0696	0.0294
1BSM1ESM	z_{10}	δ_{10}	-0.0624	0.0248
1BSM1CRM	z_{11}	δ_{11}	-0.0864	0.0615
DBSM	z_{12}	δ_{12}	-0.1518	0.0404
1BSMV	z_{13}	δ_{13}	-0.1261	0.1807
1PT	z_{14}	δ_{14}	0.9546	0.0002
2PT	z_{15}	δ_{15}	0.0625	0.1318
1TP2BSM2FSM	z_{16}	δ_{16}	0.0598	0.1043
Finishing technology / *Tehnologija završne obrade*	z_{17}	δ_{17}	-0.0394	0.0348
Drying chamber / *Sušionica*	z_{18}	δ_{18}	0.0455	0.0343
Number of workshifts / *Broj smjena*	z_{19}	δ_{19}	0.0696	0.0490
Yield of sawnwood / *Vrijednost piljenog drva*	z_{20}	δ_{20}	-0.0398	0.0093
Variance parameters / *Parametri varijance*	σ^2 = 0.4472			
	γ = 0.81			
Log likelihood function *Logaritamska funkcija vjerojatnosti*	= -70.3831			
Observations / *Broj zapažanja*	N = 203			
LR test / *LR tes*t	= 31.57			

* indicates that coeficient is statistically significant at the 5 % levels.
** Označava da je koeficijent statistički značajan na razini od 5 %.*

Table 4 Decile range of frequency distribution of technical efficiencies of Czech Sawmills (Year 2006)
Tablica 4. Raspodjela učestalosti tehničke učinkovitosti čeških pilana u intervalima od 10 % (2006. godina)

Decile range, % *Raspon, %*	**Number of enterprises** *Broj tvrtki*	**Value of technical efficiency, %** *Vrijednost tehničke učinkovitosti, %*
> 90	0	0
81 – 90	3	1.48
71 – 80	53	26.11
61 – 70	115	56.65
51 – 60	25	12.32
41 – 50	3	1.48
31 – 40	3	1.48
21 – 30	1	0.49
< 20	0	0
Mean, % / *Srednja vrijednost, %*		65.52
Minimum, % / *Minimum, %*		29.68
Maximum, % / *Maksimum, %*		85.95

Source: Computed from database "Company Monitoring Data" of CreditInfo Czech Republic, s.r.o., 2008.
Izvor: izračunano iz baze podataka "Company Monitoring Data" CreditInfo Czech Republic, s.r.o., 2008.

to the size of the Czech sawmill. The lowest measured value of technical efficiency is for small sawmills (55.67). This TE result for small sawmills can be obscured during the reduction of values of Earnings before Interest and Taxes (EBIT), volume of production and other indices mentioned in their account „Balance Sheets" and „Profit and Loss Accounts" by the company managers. The highest value of TE is obtained by large sawmills (70.98).

3.3 Test of the null hypothesis
3.3. Testiranje hipoteze

The null hypothesis specifies that Czech sawmills are technically efficient in their production, and that any variation in their output is only due to random effects. The hypothesis is defined as follows: H_0: $\gamma = 0$. The generalized Cobb-Douglas model was conducted and the Chi-square (χ^2) statistics were computed. Table 6 shows the result of the generalized Cobb-Douglas model. The null hypothesis, $\gamma = 0$, was rejected among Czech sawmills in this study. This means that the effects of technical inefficiency apply to these sawmills.

3.4 Test of significance of variable coefficients in the inefficiency model
3.4. Test značajnosti koeficijenata varijabli u modelu neučinkovitosti

The null hypothesis is formulated so that each of the estimated coefficients of the explanatory variables

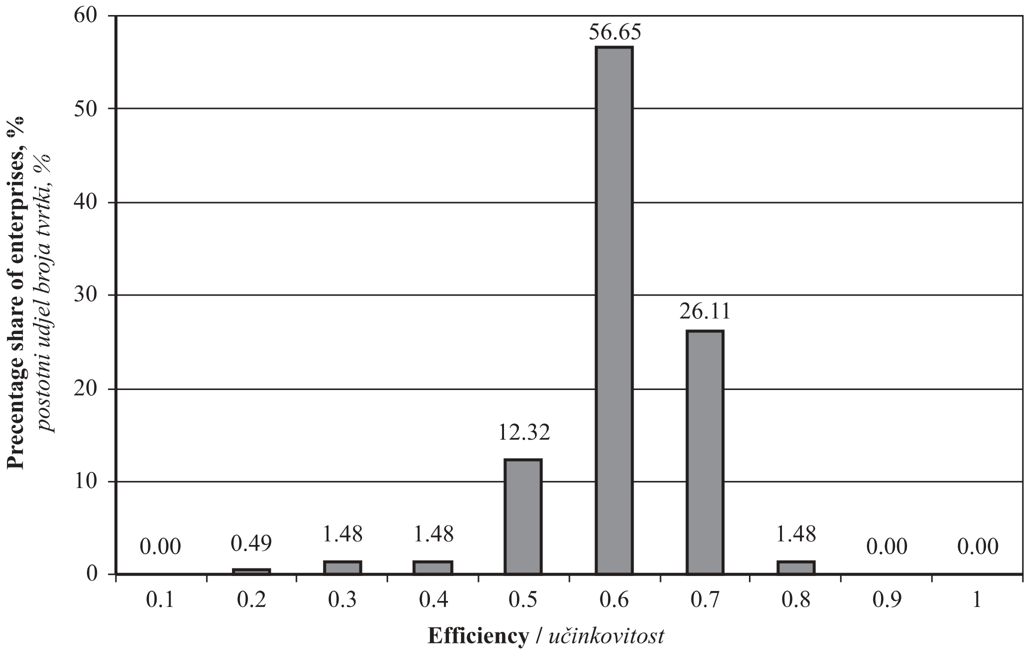


Figure 2 Frequency distribution of technical efficiencies (percentage share)
Slika 2. Raspodjela učestalosti tehničke učinkovitoste (postotni udio)

Table 5 Distribution of values of technical efficiencies (TE) according to the size of sawmills (Year 2006)
Tablica 5. Raspodjela vrijednosti tehničke učinkovitosti (TE) prema veličini pilane (2006. godina)

Size of enterprises *Veličina tvrtke*	**Number of employees***** *Broj zaposlenih****	**Number of enterprises** *Broj tvrki*	**Mean of TE, %** *Srednja vrijednost TE, %*
Micro / *vrlo mala*	< 10	160	57.22
Small / *mala*	11 - 50	29	55.67
Medium / *srednja*	51 - 250	8	59.82
Large / *velika*	250 <	6	70.98

Source: Computed from database "Company Monitoring Data" of CreditInfo Czech Republic, s.r.o., 2008.
Izvor: izračunano iz baze podataka "Company Monitoring Data" CreditInfo Czech Republic, s.r.o., 2008.
*** Distribution according the definition of the size enterprises by the I. Injunction of European Commission, no.70/2001, digest 364/2004 Ministry of Trade and Industry.
***** Raspodjela prema definiciji veličine tvrtke dana u dokumentu I. Injunction of European Commission, br.70/2001, digest 364/2004, Ministarstvo trgovine i industrije.*

Table 6 Test of hypothesis on technical efficiency
Tablica 6. Testiranje hipoteze o tehničkoj učinkovitosti

H_O: Czech sawmills are fully technically efficient (γ = 0) *H_O: Češke pilane tehnički su potpuno učinkovite (γ = 0).*				
Equation *Jednadžba*	**Null hypothesis** *Nul-hipoteza*	**Log (Likelihood)** *Log (vjerojatnost)*	χ^2_{Computed}	$\chi^2_{0,95;7}$
1	H_0: γ = 0	-0.7038	31.57****	14.07

Source: Computed from database "Company Monitoring Data" of CreditInfo Czech Republic, s.r.o., 2008.
Izvor: izračunano iz baze podataka "Company Monitoring Data" CreditInfo Czech Republic, s.r.o., 2008.
**** Indicates that null hypothesis is rejected at the 5% level.
***** Označava da se nul-hipoteza odbacuje na razini značajnosti od 5 %.*

of the inefficiency model of the stochastic frontier production function is statistically significant (variables have some significant relationship with the TE of Czech sawmills).

The hypothesis of the inefficiency model is defined as: H_0: $\delta_i = 0$, where δ_i is the coefficient associated with the given adopted production technology (δ_1 δ_2 ... δ_{16}), with the given adopted finishing technology (δ_{17}) and drying chamber (δ_{18}), with the number of working shifts (δ_{19}) and with the yield of sawn wood production (δ_{19}). The statistical test used to test the null hypothesis in this model is the t-ration test, where the coefficient α is statistically significant at a 5 % level, with a 203 degree of freedom. Table 7 shows the results of t-ration tests for coefficients of the inefficiency model of the stochastic frontier production function for Czech sawmills. It was determined that all inefficiency variables were significantly different from zero; hence, the null hypothesis was accepted by the coefficients associated with 1FSM, 2FSM, 1FSM1CSM, 1FSM1BSM, 2FSM1BSM, 1BSMH, 1BSM1ESM, 1BSMV, 1PT, 1TP2BSM2FSM, finishing technology, drying chamber, number of working shifts and yield of sawn wood. All these coefficients, except for the number of working shifts, have a negative sign, which suggests that using these technologies has a positive effect on the efficiency of companies.

The coefficients associated with 2FSM1CSM, 3FSM, 4FSM, 1BSM1CRM, DBSM and 2PT technology are not statistically significant at a 5 % level, given a 203 degree of freedom, because in the sample of sawmills, there is statistically a relatively small number of the above-mentioned types of adopted production technologies.

The positive value (0.0696) of the coefficient *number of working shifts* means that this coefficient has a negative impact on the companies' technical efficiency. This negative effect can be explained by the fact that over 80% of the producers in the sample of sawmills have only one working shift daily.

4 CONCLUSION
4. ZAKLJUČAK

This study has investigated the technical efficiency of Czech sawmills. A model of a stochastic frontier production function is proposed for cross-sectional data observed from the year 2006. This study has established that Czech sawmills were not fully technically efficient in the use of production inputs. The mean technical efficiency of Czech sawmills is about 65.52 %. This means that companies could theoretically improve their productivity by 34.48 % with the same quantity of inputs. Estimates of technical efficiency differ substantially among the companies, ranging between a minimum of 29.68 % and a maximum of 85.95 %. Out of 203 companies, approximately 82.76 % have a technical efficiency rate between 60 % and 80 %.

The analysis of the influence of variables associated with an adopted type of production technology is accepted for 1FSM, 2FSM, 1FSM1CSM, 1FSM1BSM, 2FSM1BSM, 1BSMH, 1BSM1ESM, 1BSMV, 1PT,

Table 7 T-ratio test for significance of coefficients of variables of the inefficiency model of Czech Sawmills
Tablica 7. T-test značajnosti koeficijenata varijabli u modelu neučinkovitosti na primjeru čeških pilana

H_O: Variables associated with the adoptered production technology have significant effect on technical efficiency of Czech Sawmills ($\delta_i = 0$) *H_O: Varijable povezane s primijenjenom tehnologijom proizvodnje imaju značajan utjecaj na tehničku učinkovitost čeških pilana ($\delta_i = 0$).*				
Variable / *Varijabla*	**Parameter** *Parametar*	**Coefficient** *Koeficijent*	**T-ratio** *T-omjer*	**T-critical** *T-kritični*
1FSM *	δ_1	-0.0520	1.752	1.65
2FSM *	δ_2	-0.0173	1.813	1.65
1FSM1CSM *	δ_3	-0.0281	1.910	1.65
1FSM1BSM *	δ_4	-0.0677	1.757	1.65
2FSM1CSM	δ_5	0.1115	1.307	1.65
2FSM1BSM *	δ_6	-0.0248	1.761	1.65
3FSM	δ_7	0.2292	1.167	1.65
4FSM	δ_8	-0.1284	1.248	1.65
1BSMH *	δ_9	-0.0696	1.979	1.65
1BSM1ESM *	δ_{10}	-0.0624	1.866	1.65
1BSM1CRM	δ_{11}	-0.0864	1.476	1.65
DBSM	δ_{12}	-0.1518	1.181	1.65
1BSMV *	δ_{13}	-0.1261	1.791	1.65
1PT *	δ_{14}	0.9546	1.688	1.65
2PT	δ_{15}	0.0625	1.074	1.65
1TP2BSM2FSM *	δ_{16}	0.0598	1.673	1.65
Finishing technology * / *Tehnologija završne obrade*	δ_{17}	-0.0394	1.933	1.65
Drying chamber / *Sušionica* *	δ_{18}	0.0455	1.828	1.65
Number of workshifts / *Broj smjena* *	δ_{19}	0.0696	1.719	1.65
Yield of sawnwood * / *Vrijednost piljenog drva*	δ_{20}	-0.0398	2.258	1.65

Source: Computed from database "Company Monitoring Data" of CreditInfo Czech Republic, s.r.o., 2008.
Izvor: izračunano iz baze podataka "Company Monitoring Data" CreditInfo Czech Republic, s.r.o., 2008.
* Indicates that coeficient is statistically significant at the 5 % levels.
** Označava da je koeficijent statistički značajan na razini od 5 %.*

1TP2BSM2FSM, finishing technology, drying chamber and the yield of sawn wood production. All these mentioned technologies had a significant influence on their TE in the study area.

2FSM1CSM, 3FSM, 4FSM, 1BSM1CRM, DBSM and 2PT technology did not have a significant influence on their TE because there was a relatively small number of sawmills in the observed sample which adopted this production technology.

The coefficient *number of working shifts* has a negative impact on a company's technical efficiency. This effect can be explained by the fact that over 80% of producers in the sample of sawmills have only one daily working shift. The above-mentioned Table 5 shows the distribution of the mean values of technical efficiencies according to the size of Czech sawmills. The lowest measured value of technical efficiency is shown by small sawmills (55.67). This TE result of small sawmills can be obscured during the reduction of values of Earnings before Interest and Taxes (EBIT), volume of production and other indices mentioned by the managers of the companies. The highest technical efficiency has been established for large sawmills (70.98).

Technical efficiency increases with the increasing size of sawmills. This means that larger sawmills in the sample of companies are more effective.

This study was financially supported by the European Social Fund and the Public Budget of the Czech Republic for the period 2005–2008 (project arrangement JPD3, number CZ.04.3.07/4.2.01.1/0016). This project has been processed within programme action 4.2, support of cooperation between science and research institutes and businesses, support of innovations in the Czech Republic.

5 REFERENCES
5. LITERATURA

1. Aigner, D.; Lovell, C.A.K.; Schmidt, P. 1977: Formulation and estimation of stochastic frontier production function models, Journal of Econometrics, 6: 21 – 37.

2. Battese, G.; Coelli, T., J. 1995: A model for technical inefficiency effects in a stochastic frontier production function and panel data, Empirical Economics, 20: 325 –332.
3. Coelli, T.J. 1996: A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation, No 7/96, CEPA Working Papers, ISSN 1 86389 4950, 21 – 24.
4. Faforullah, M. 1999: Production technology, elasticity of substitution and technical efficiency of the handloom textile industry of Bangladesh, Applied Economics, 31: 437 – 442.
5. Faria, A.; Fenn, P.; Bruce, A. 2005: Production technologies and technical efficiency: evidence from Portuguese manufacturig industry, Applied Economics, 37: 1037 – 1046.
6. Green, W.H. 2002: Program LIMDEP, Econometric Software, Inc. New York.
7. Green, W.H. 2003: Econometric Analysis/LimDep Users Manual.
8. Lesourne, J.; Barré, R. 1991: On the emergence of a new techno-economic system, Technology and Produktivity, the Challenge for Economic Policy, OECD Paris.
9. Lovell, C.A.K. 1993: Production frontiers and productive efficiency, in the Measurement of Productive Efficiency (Eds.), Oxford University Press, New York, 3 – 67.
10. Mallok, J. 2005: Development of productivity of Enterprises in East Germany – result of case study (1992 – 2002), ZAF 4, 510 – 530.
11. Meeusen, W.; van den Broeck, J. 1977: Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. International Economic Review, 18: 435 – 444.
12. Peschler, E. 1974: Time utilization and economic efficiency of manufacturing line in wood-processing industry, Holz als Roh- und Werkstoff, 32: 436 – 442.
13. Saljé, E.; Meyer, B. 1975: Time utilization, economic efficiency and manufacturing costs of Frame Sawmill, Holz als Roh- und Werkstoff, 33: 171 – 175.
14. *** 1992: Account rules no. 563/1991., part III., §21a.
15. *** 2001: The I. injunction of Europen Commission, no. 70/2001, digest 364/2004 Ministry of Trade and Industry.
16. *** 2008: The database Company Monitoring, version 2008, Creditinfo Czech Republic, Ltd. Corporation.
17. *** EWD, 2008: http://www.ewd.de.
18. *** LINCK, 2008: http://www.linck-hvt.de.

Corresponding address:

Assistant PREMYSL SEDIVKA, BSc.

Department of Wood Processing
Czech University of Life Sciences Prague,
Faculty of Forestry and Wood Sciences
Kamycka 1176
165 21 Prague
Czech Republic
e-mail: sedivka@fld.czu.cz

Andrew A. Erakhrumen[1]

Estimating the Extent of Influence of two Intrinsic Fuelwood Properties on Acceptance/Retention of some Woody Species in Agroforestry Practices in Southwest Nigeria

Procjena veličine utjecaja dvaju bitnih svojstava ogrjevnog drva na primjenu nekih vrsta drva u agrošumarstvu jugozapadne Nigerije

Original scientific paper · Izvorni znanstveni rad
Received – prispjelo: 24. 9. 2009.
Accepted – prihvaćeno: 18. 11. 2009.
*UDK: 630*812.144; 630*831.1*

ABSTRACT • *Biofuel is presently still central to survival and sustenance of livelihoods in many parts of sub-Sahara African region. Demand for woodfuel in the form of firewood and charcoal is continuously increasing in this region, and it is therefore necessary to devise and sustain feasible production methods bearing in mind the influence of native intelligence, indigenous/traditional knowledge and/or users' perspectives on their success. In line with this, a survey was carried out by administering questionnaire to 240 respondents in 8 rural communities of Akinyele and Ido Local Government Areas of Oyo State, Nigeria, where the predominant type of agroforestry system practiced is that of scattered trees in croplands, to elicit information on wood species used as fuelwood and preferred by the respondents for incorporation into or retention in most agroforestry plots, out of which 179 (i.e. 75% of the total number of questionnaires administered) were successfully retrieved for statistical analyses. Twelve woody species were selected on the basis of respondents' preference and prioritization. The mean specific gravity (SG) and net calorific values (NCV) of the species were found to range between 0.42-0.84 g · cm^{-3} and 14.65-21.88 MJkg^{-1} respectively. The linear regression equation developed predicting cumulative numerical values (CNV) attached to each ranking position indicating respondents' preference using SG and NCV together as predictors gave a coefficient of determination (R^2) of 77.1% with an ANOVA result showing a significant relationship between CNV and SG. Predicting CNV using only SG as a predictor gave R^2 of 75.7% while that for using NCV alone as a predictor gave R^2 of 67.7% with ANOVA showing significant relationship between CNV and each predictor for both equations, respectively. Based on the outcome of the study, it was recommended that users' perspective, native intelligence and indigenous/traditional knowledge should be part of the criteria for selecting potential fuelwood species for incorporation into or retention in agroforestry systems in this study area and others with similar characteristics.*

[1] Author is professor at Department of Forest Resources Management, University of Ibadan, Ibadan, Nigeria.
[1] Autor je profesor u Zavodu za upravljanje šumskim resursima Sveučilišta Ibadan, Ibadan, Nigerija.

Keywords: *agroforestry, biomass, biofuel, fuelwood, net calorific value, species selectivity, specific gravity, prioritization, sub-Sahara Africa*

SAŽETAK • *Biogorivo je vrlo važno za opstojnost i održivost življenja u mnogim dijelovima regije uz afričku pustinju Sahara. Potražnja ogrjevnog drva i drvenog ugljena u toj je regiji u stalnom porastu. Prema tomu, nužno je istražiti, osmisliti i primijeniti moguće proizvodne metode uzimajući u obzir inteligenciju, dosadašnja iskustva i spoznaje te očekivanja i stajališta proizvođača biogoriva. U skladu s tim, provedeno je istraživanje primjenom ankete na uzorku od 240 ispitanika iz osam zajednica stanovnika Nigerije, gdje se najčešće prakticira sustav agrošumarstva s uzgojem stabala raštrkanih na poljoprivrednim zasadima. Cilj provednih istraživanja bio je anketiranjem dobiti informacije o vrstama drva koje se rabe za ogrjev i utvrditi koje vrste ispitanici preferiraju za uzgoj i zadržavanje na agrošumarskim zemljištima. Prikupljeno je 179 ispunjenih anketa (tj. 75 % ukupnog broja poslanih anketa) koje su zadovoljile uvjete za statitičku analizu. Dvanaest vrsta drva selektirano je na temelju odgovora i preferencija ispitanika.*

Srednja gustoća (SG) izabranih vrsta drva iznosi 0,42 – 0,84 g·cm^{-3}, a neto kalorijska vrijednost (NCV) kreće se u rasponu 14,65 – 21,88 MJ · kg^{-1}. Razvijena je višestruka regresijska jednadžba koja predviđa kumulativne numeričke vrijednosti (CNV) pridružene svakoj rang-poziciji vrste drva, a one pokazuju preferencije ispitanika. Kao veličine za predviđanje upotrijebljene su SG i NCV. Dobiven je koeficijent determinacije (R^2) 77,1 % i ANOVA rezultat koji pokazuje signifikantnu korelaciju (uz prag signifikantnosti $p<0{,}05$) između CNV i SG/NCV. Ako se za predviđanje CNV-a koristi samo veličina SG, dobije se koeficijent determinacije 75,7 %, a ako se za predviđanje primijeni veličina NCV, dobije se koeficijent determinacije od 67,7 %, a ANOVA test pokazuje signifikantu korelaciju između veličine CNV i veličina koje služe za predviđanje, SG i NCV. Na temelju rezultata provedenih istraživanja preporučuje se da stajališta korisnika, inteligencija i iskustvena tradicionalna znanja trebaju biti neki od kriterija pri odluci o izboru vrsta drva za ogrjev, koje će se inkorporirati i uzgajati na agrošumarskim zemljištima u uvjetima regija uz pustinju ili sličnima.

Ključne riječi: *agrošumarstvo, biomasa, biogorivo, ogrjevno drvo, neto kalorijska vrijednost, izbor vrste, gustoća, prioritet, subpustinjska Afrika*

1 INTRODUCTION
1. UVOD

The use of biomass energy, predominantly from wood, in many rural, peri-urban, and some urban areas of the developing countries particularly those of sub-Sahara Africa (SSA), is not only central to domestic and commercial cooking and heating including sustenance of livelihoods but is also increasing in quantity and intensity of use, with a trend that does not appear to have the possibility of reversing/or declining in the foreseeable future (Hall and deGroot, 1987; Leach, 1992; Barnes and Floor, 1996; FAO, 2001; 2007; Temu, 2002; Erakhrumen, 2005; 2007; 2008b).

Apart from the prevailing use of biomass in the developing countries for this purpose, developed countries, such as Austria, Finland, Germany, Sweden, and many others are also presently increasing the volume of these resources from this energy source in their energy mix, with projected high possibilities of future increases (FAO, 2007), the bulk of which is expected to be most likely sourced from the rural areas of the developing countries in the very near future (Johansson et al. 1993; Erakhrumen, 2007).

It is noteworthy that recent estimates showed that about 99.99% of fuelwood harvested in Africa is presently consumed locally (FAO, 2007). Owing to this trend of use in these and other developing countries and the likely future dependence of many developed countries on this part of the world for supply, there is present necessity for devising and improving more sustainable production methods of generating this resource, in the short and long term, for the inhabitants of this region and export to other parts of the world when the need arises, from sustainable sources.

Agroforestry systems, which is a collective name for land use practices and technologies where woody perennials are deliberately used on the same land management unit as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (ICRAF, 1983), has been identified as a veritable source of wood for different purposes (ICRAF, 1991), one of which is fuelwood, in the different localities of SSA and other parts of the developing regions.

These systems, although, an age-long worldwide traditional practices, are currently being scientifically developed and continuously modified in many parts of the world thereby receiving more global attention and scientific recognition (Erakhrumen, 2008a.). Irrespective of these efforts, challenges still exist as regards the various methods of and/or rationale for selecting woody species for incorporation into and/or retention in these systems including extension strategies and services.

Agricultural extension for instance, has traditionally been based on a top-down model, where research scientists developed technological innovations that were then promulgated by extension agents that farmers were expected to adopt (Packham, 2001). This approach was based on a theoretical model of *diffusion of innovations* (Rogers, 1983), a model that has become limiting and contradictory, while also not explaining farmer behaviour, resulting in its being substantially rejected (Vanclay and Lawrence, 1994).

In the same vein, many of the agroforestry systems designs, e.g. taungya practices introduced to some parts of Nigeria were based on external perspectives that were not in tandem with local realities in the past as they did not meet the needs and aspirations of the local communities, thereby also leading to their rejection by farmers, and thus, resulting in failure of many of these systems (Mahlako, 1993; Kio, 2002).

In order to avoid similar situations, whereby local or indigenous knowledge were trivialised and marginalised in the past, thus ignoring the contributions farmers, for instance, might make to agricultural technology development (Packham, 2001) in the present and future designs, it will be necessary to incorporate the views and contributions of different stakeholders, particularly those in the rural areas, in terms of their generational experience, native intelligence, and/or indigenous/traditional knowledge into methods to be developed for selecting wood species for agroforestry systems (Erakhrumen and Ogunsanwo, 2005; Ogunsanwo and Erakhrumen, 2006; Erakhrumen, 2006; 2008a; 2008b; 2009).

Since it is only by participating in the development of an innovation with the farmer or farming community and other stakeholders that many challenges concerning agroforestry schemes can be holistically addressed, this study was therefore carried out to estimate the extent of influence of two intrinsic fuelwood properties i.e. specific gravity (SG) and energy value, (by evaluating the net calorific value, NCV) of wood on its acceptance for and/or retention in agroforestry systems based on native intelligence/indigenous knowledge, using wood samples from trees scattered in croplands, which is the predominant type of agroforestry system practiced in Akinyele and Ido Local Government Areas (LGAs) of Oyo State, Nigeria, as a case study.

2 MATERIALS AND METHODS
2. MATERIJALI I METODE

2.1 Study Area
2.1. Područje istraživanja

The wood samples for the experiment were obtained from trees sourced randomly from agroforestry plots in Akinyele and Ido LGAs of Oyo State, Southwest, Nigeria (Latitude 7°17′–7°26′N and Longitude 3°17′–3°30′E), where the predominant method of agroforestry system practiced is scattered trees in croplands (with most of the trees not planted by the farmers interviewed). This study area is located in between the humid and sub-humid tropical climate.

The mean annual rainfall ranges from 1117.1 and 1693.3 mm. The rainfall pattern has a characteristic bimodal distribution with peaks usually in June or July and September and the period of low precipitation in August with four months of dry season (December–March). The annual temperature ranges from an average minimum of 24.6 °C to average maximum of 31.5 °C. The mean monthly relative humidity reaches a minimum of 52 % in February and a maximum of 83 % in August (IITA, 1993; FRIN, 1999).

2.2 Questionnaire survey
2.2. Anketiranje

In order to prioritize the wood species in croplands in this study area and obtain those preferred by farmers in their croplands, a questionnaire was drawn for administration on this target group, in such a way as to utilize their indigenous knowledge/native intelligence for the prioritization of the species.

A random survey of respondents was done using questionnaire targeting two hundred and forty (240) respondents. One hundred and twenty (120) copies of a set of questionnaire were randomly administered in each LGA. This was achieved by partitioning each LGA into four (4) geographical zones i.e. North, West, South, and East based on the information obtained from each LGA headquarters with a village/community randomly selected to represent each zone in each LGA as follows: Akinyele LGA: North: Aba Isale Community, South: Papa Malu Community, West: Motosho Community, East: Bagadaje Community. Ido LGA: North: Odetola Community, South: Dagilogba Community, West: Tade Community, East: Patako Community.

Thirty (30) copies of the questionnaire were randomly administered on respondents in each geographical zone in order to ensure randomization, equitable distribution, and even spread of the questionnaire in the two LGAs. The questionnaire was drawn in such a way that the respondents listed all the woody species in his/her farm and prioritized them in terms of how preferable they are for agroforestry, from his/her perspective based on their experience of wood with high density and energy value. The respondents listed the woody species from 1 to 10 in order of preference with the species in position number 1 being the most preferred while the species in position number 10 being the least preferred out of the ten species in that order.

Numerical values of 1 to 10 were allocated to each position on the ranking. Numerical values were allocated to each position on the ranking in descending order i.e. numerical value 10 was allocated to position number 1 on the ranking while numerical value 1 was allocated to position number 10 on the ranking in that order.

Collating the numerical values allocated to each position occupied by each species on the ranking, it was found that twelve species had the highest cumulative values as against the ten species that were originally planned to be selected for laboratory analysis. These methods of questionnaire administration and allocation of values to ranking position of species had been extensively described by Erakhrumen, (2005).

The number of copies of questionnaires that was retrieved from Akinyele and Ido LGAs was 83 and 96, respectively, out of the 120 administered, totalling 179 owing to incomplete information in and non-retrieval of some of the questionnaire totalling sixty one (61).

The 179 copies of questionnaire served as the effective sample size used in the subsequent analyses.

2.3 Preparation of wood samples
2.3. Priprema uzoraka od drva

Four trees per each species tabulated in Table 1 were randomly located on agroforestry plots in the study area, where the predominant method of agroforestry system is the one of scattered trees in croplands. Wood samples were randomly obtained from tree stems at diameter at chest height (dch), that is 130 cm from the ground in such a way that the samples obtained represent all the wood types (sapwood, transition wood, and heartwood) by taking samples from different position radially across the bole at this position and thoroughly mixing them together to ensure randomization.

The ages of the trees were unknown owing to the fact that it was claimed by almost all the respondents in their response to the questionnaire that most of the trees were not planted by them in this study area. Samples were adequately coded for easy identification and taken to the laboratory for initial moisture content (MC), SG, and NCV determination.

Table 1: Prioritized wood species selected for their initial moisture content, specific gravity, and Net Calorific Value determination
Tablica 1. Prioritetna lista vrsta drva izabranih za određivanje početnog sadržaja vode, gustoće i neto kalorijske vrijednosti

Species scientific names *Latinski naziv vrste*	**Family** *Porodica*
Annona senegalensis Pers.	Annonaceae
Anogeissus leiocarpus (DC.) Guill. & Perr.	Combretaceae
Bridelia ferruginea Benth.	Euphorbiaceae
uto*Daniellia oliveri* (Rolfe) Hutch. & Dalziel	Caesalpiniaceae
Detarium microcarpum Guill. & Perr.	Caesalpiniaceae
Gardenia ternifolia Schumach. & Thonn.	Rubiaceae
Hymenocardia acida Tul.	Hymenocardiaceae
Lophira lanceolata Tiegh. ex Keay.	Ochnaceae
*Parkia biglobosa (*Jacq.) R. Br. ex G. Don.	Mimosaceae
Terminalia avicennioides Guill. & Perr.	Combretaceae
Triplochiton scleroxylon K.Schum.	Sterculiaceae
Vitellaria paradoxa C.F. Gaertn.	Sapotaceae

2.4 Determination of Initial Moisture Content
2.4. Određivanje početnog sadržaja vode

One of the main factors affecting the value of wood for fuel is its moisture content (MC) (Forest Service, 1994). The amount of moisture in wood is termed as MC. It can be expressed as a percentage of either dry or wet weight. For most purposes, the MC of lumber is based on dry weight, but the MC of wood fuel is usually based on wet weight (FPL, 1999).

The properly coded wood samples were placed in a regulated oven at a temperature range of 95$\pm$3 °C until a constant weight was achieved. MC on wet weight basis was calculated in conformity with ASTM D 4442 (ASTM, 1984), using the equation:

Moisture Content (%) = (Fresh weight – Oven dry weight) $(\text{Fresh weight})^{-1}$ x 100

2.5 Determination of Specific Gravity
2.5. Određivanje gustoće

SG was measured for ten (10) samples from each of the four trees per species of predetermined weight using the mercury displacement method i.e. ASTM D 2395 (ASTM, 1989) at mean ambient room temperature of 25$\pm$2 °C after oven drying the wood samples. 80 ml volume was used in a 100 ml beaker, which made it possible to measure the wood SG directly with or without bark as obtained.

2.6 Determination of Net Calorific Value
2.6. Određivanje neto kalorijske vrijednosti

The oven-dried wood samples of the twelve species were hammer milled differently to pass through a mesh of < 3.5 mm, pelleted, and one gram (1 g) of each sample was measured in succession using electric portable balance, placed in the steel capsule of the oxygen bomb calorimeter and completely burnt in excess oxygen to determine the NCV in ten (10) replications. The maximum temperature rise in the bomb calorimeter was measured with the aid of thermocouple and galvanometer systems and the values obtained were computed.

2.7 Statistical analyses
2.7. Statistička analiza

The SG and NCV obtained from all the species were subjected to basic descriptive statistical analyses such as mean, standard deviation, and standard error of mean. Linear regression analysis was employed in developing predictive equations. Graphical representation of initial MC was done using Microsoft Office Excel® 2003 while the statistical package used for the analyses was Minitab13® for Windows®.

3 RESULTS
3. REZULTATI

The twelve woody species that were at the top of the priority ranking of the respondents based on the cumulative numerical values (CNV) attached to each position on the ranking are tabulated in Table 1. Fig. 1 has the mean initial MC while Table 2 shows the mean values for SG and NCV, standard deviation and standard error of mean for the properties of twelve species. The initial MC of the samples for the study was determined on wet weight basis. The mean initial MC (as received) was calculated for all the samples from each species and was found to range approximately from 46.10 % for *Anogeissus leiocarpus* to 88.20 % for *Daniellia oliveri*.

Results of linear regression for equation predicting CNV from both SG and NCV together is tabulated

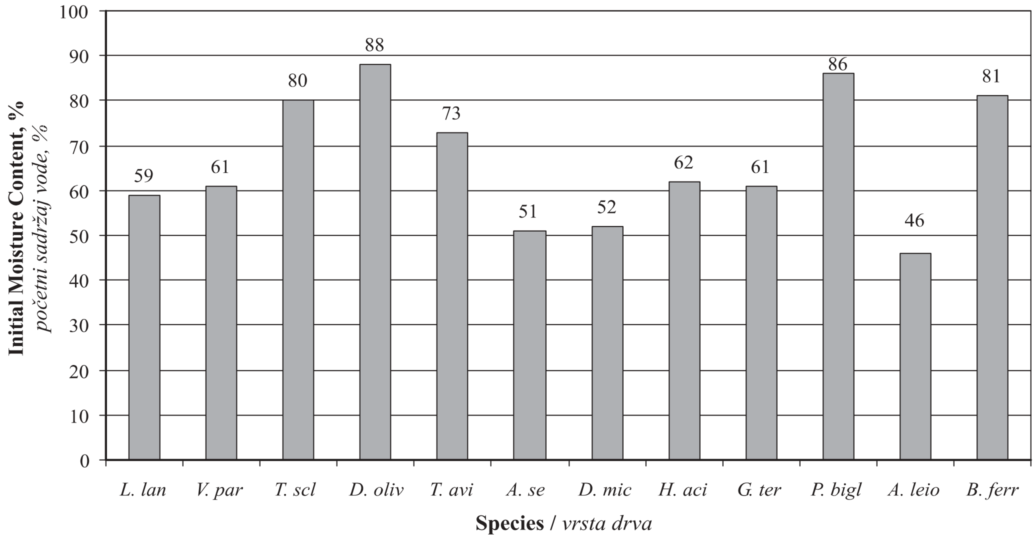


Figure 1 Mean initial moisture content for wood samples from twelve species
Slika 1. Srednje vrijednosti početnog sadržaja vode za uzorke od 12 vrsta drva

in Table 3 while Table 4 shows the one-way ANOVA for the regression equation. Table 5 presents the results of linear regression for equation predicting CNV from SG alone, while Table 6 shows the one-way ANOVA for the regression equation. Table 7 and 8 show the results of linear regression for equation predicting CNV from NCV alone and one-way ANOVA for the regression equation, respectively. The P values in the ANOVA tables are the actual probability of tests of adequacy of the models and were found to be lower than or equal to 0.05 except that for NCV in the model depicted by equation 1 (Table 3).

4 DISCUSSION
4. DISKUSIJA

According to the literature, the success of any agroforestry system is largely dependent on stakeholders' participation and cooperation, particularly those of the farmers and inhabitants of the rural areas. This fact resulted in the idea of using this target group's ranking and prioritization of woody component of scattered trees in croplands, which is the predominant agroforestry system in this study area, as the basis for selecting woody species for this study (e.g. Erakhrumen, 2008a; 2009).

Table 2 Descriptive statistics for Specific Gravity and Net Calorific Values for the twelve wood species
Tablica 2. Deskriptivna statistika za podatke gustoće i neto kalorijske vrijednosti za uzorke od 12 vrsta drva

Species *Vrsta drva*	**Specific Gravity, g·cm^{-3}** *Gustoća, g·cm^{-3}*			**Net Calorific Values** *Neto kalorijska vrijednost*		
	Mean values* at 25°C *Srednja vrijednost pri 25 °C*	SD *Standarda devijacija*	SE Mean *Standardna pogreška*	Mean values *Srednja vrijednost* MJ·kg^{-1}	SD *Standarda devijacija*	SE Mean *Standardna pogreška*
Lophira lanceolata	0.81	0.01	0.03	21.68	0.08	0.02
Vitellaria paradoxa	0.85	0.03	0.08	19.47	0.02	0.06
Triplochiton scleroxylon	0.42	0.03	0.06	14.65	0.15	0.05
Daniellia oliveri	0.64	0.03	0.02	16.03	0.06	0.02
Terminalia avicennioides	0.79	0.05	0.01	18.25	0.12	0.04
Annona senegalensis	0.71	0.03	0.07	17.71	0.06	0.02
Detarium microcarpum	0.73	0.02	0.03	17.67	0.04	0.01
Hymenocardia acida	0.81	0.02	0.04	19.00	0.08	0.03
Gardenia ternifolia	0.81	0.03	0.08	18.46	0.22	0.07
Parkia biglobosa	0.83	0.03	0.07	19.63	0.10	0.03
Anogeissus leiocarpus	0.83	0.02	0.03	18.63	0.28	0.09
Bridelia ferruginea	0.81	0.02	0.05	18.04	0.11	0.03
Mean / *srednja vrijednost*	0.75			18.25		

*Values are means for 10 test samples per tree / *vrijednosti odgovaraju srednjoj vrijednosit za deset uzoraka svake vrste drva*; SD – standard deviation / *standardna devijacija*; SE Mean – standard error of mean /*standardna pogreška srednje vrijednosti*

Table 3 Results of linear regression for Equation 1
Tablica 3. Rezultati linearne regresijske analize za jednadžbu 1.

Predictor *Varijabla modela*	**Coefficient** *Koeficijent*	**SE Coefficient** *SE koefeicijent*	R^2, %	*T*	*P*
Constant / *konstanta*	344.55	94.60		3.64	0.005
SG	287.20	126.7	77.1	2.27	0.050
NCV	11.101	8.681		1.28	0.233

Table 4 One-way ANOVA for Regression Equation 1
Tablica 4. Jednosmjerna ANOVA analiza za regresijsku jednadžbu 1.

Source of Variation / *Izvor varijacije*	*DF*	*SS*	*MS*	*F*	*P*
Regression / *regresija*	2	30204	15102		
Residual Error / *preostala pogreška*	9	6957	773	19.54	0.001
Total / *ukupno*	11	37160			

Table 5 Results of linear regression for Equation 2
Tablica 5. Rezultati linearne regresijske analize za jednadžbu 2.

Predictor *Varijabla modela*	**Coefficient** *koeficijent*	**SE Coefficient** *SE koefeicijent*	R^2, %	*T*	*P*
Constant / *konstanta*	445.02	54.35	75.7	8.19	0.000
SG	423.09	71.31		5.93	0.000

Table 6 One-way ANOVA for Regression Equation 2
Tablica 6. Jednosmjerna ANOVA analiza za regresijsku jednadžbu 2.

Source of Variation / *Izvor varijacije*	*DF*	*SS*	*MS*	*F*	*P*
Regression / *regresija*	1	28940	28940		
Residual Error / *preostala pogreška*	10	8221	822	35.20	0.000
Total / *ukupno*	11	37160			

Table 7 Results of linear regression for Equation 3
Tablica 7. Rezultati linearne regresijske analize za jednadžbu 3.

Predictor *Varijabla modela*	**Coefficient** *Koeficijent*	**SE Coefficient** *SE koefeicijent*	R^2, %	*T*	*P*
Constant / *konstanta*	259.70	103.30	67.7	2.51	0.031
NCV	27.589	5.631		4.90	0.001

Table 8 One-way ANOVA for Regression Equation 3
Tablica 8. Jednosmjerna ANOVA analiza za regresijsku jednadžbu 3.

Source of Variation / *Izvor varijacije*	*DF*	*SS*	*MS*	*F*	*P*
Regression / *regresija*	1	26234	26234		
Residual Error / *preostala pogreška*	10	10927	1093	24.01	0.001
Total / *ukupno*	11	37160			

Owing to the fact that listing and prioritization of wood species were done by each respondent, many species made their lists and subsequent rankings but the twelve that featured mostly and had the highest CNV were the ones selected for the laboratory analyses. The necessity for prioritizing tree and shrub species for agroforestry purposes has also been earlier highlighted in some studies such as Popoola et al., (1996); Erakhrumen, (2005, 2008a, 2009).

The data obtained from the experiment for the determination of initial MC gave variable mean values (Fig. 1). The knowledge of the presence and quantity of this wood constituent is important if it is to be used for fuel since moisture generally decreases wood calorific value as established by a number of earlier investigations (Murphy et al. 1974; Ince, 1977; Panshin and deZeeuw, 1980).

Nonetheless, it is important to note that MC is not an intrinsic property of wood, as also noted by Erakhrumen, (2006), since it may vary with species due to differences in the hygroscopicity of different fiber complexions (Senelwa and Sims, 1999) and it may also vary from one tree part to another (Hakkila, 1984). It is often lowest in the stem and increases toward the roots and crown in many species. Apart from physiological differences that might cause variation in MC in different plant parts, seasonal changes and geographic location also contribute towards its difference among different species (Diaz and Golueke, 1981). Thus, much emphasis was not laid on initial MC of the species in this study since the NCV was determined for oven-dry samples of the twelve species.

Apart from the mean SG value for *T. scleroxylon,* which was 0.42, the remaining eleven species had values ranging between 0.64 and 0.85, values comparable to the ones obtained for some wood species obtained from some agroforestry systems by Shanavas and Kumar, (2006). It has been established that SG is an intrinsic factor that has influence on wood quality and many of its other properties (Panshin and deZeeuw, 1980; Larson *et al.*, 2001). It is also said to indicate the amount of actual wood substance present in a unit volume of wood (Zobel and Jett, 1995).

It is important to note that many other factors, that were not part of this study, can also influence the SG of wood e.g. source of wood material along and across the stem (Akachuku, 1980; Ogunsanwo and Onilude, 2000; Espinoza, 2004; Shanavas and Kumar, 2006), age of trees, silvicultural and/or management regimes, geographical and site factors (Akachuku, 1980; Bada, 1990), genetic influences, among others.

The NCV or lower heating value of wood is the total amount of heat released during combustion, less that taken up in heating and vaporizing its MC. It is a more practical value in that it is a measure of the usable heat released when wood is burned. In the case of oven-dried wood, the only water expected or likely to be involved is the relatively small amount produced by the chemical reaction of the hydrogen contained in the wood with oxygen during combustion (Foley, 1986).

The mean NCV obtained for the twelve species had values in the range comparable with those obtained in studies by Harker *et al.*, (1982); Lucas and Fuwape, (1984); Deibold and Bridgwater, (1997); Twidell, (1998); Ladipo *et al., (2002); Ogunsanwo et al.*, (2008). As stated for SG, other factors, not investigated in this study, like presence of other combustible material in wood (Panshin *et al.,* 1962; Tillman, 1978; Harker *et al.*, 1982; Wang *et al.,* 1989; Groves and Chivuya, 1989; Jain, 1994), influence of various parts of species and position of wood along and across the bole (Puri *et al.*, 1994; Oluwadare and Omole, 1999; Lemenih and Bekele, 2004), age of species (Klasnja *et al.*, 2002; Lemenih and Bekele, 2004), variation of the components properties of species (Sheng and Azevedo, 2005), species' genetic character and biochemical composition (Kataki and Konwer, 2002), difference in applied silvicultural techniques during growth (Senelwa and Sims, 1999), source of provenances, geographical region, seed source, types and nutrient status of soils on which the species are grown among others may also be important when fuel value of wood is to be determined.

In order to estimate the extent of contribution of the properties evaluated i.e. SG and NCV to respondents' preference of species for agroforestry in this study area, three regression equations were developed. The first one was a multivariate of the type ($y = b_o + b_1x_1 + b_2x_2$) predicting CNV from both SG and NCV (Equation 1).

$$\text{CNV} = 345 + 287\ \text{SG} + 11.1\ \text{NCV} \qquad \text{Equation 1}$$

The coefficient of determination (R^2) obtained for the equation (Table 3) showed that 77.10% represents the proportion of variation in the CNV explained by both the SG and NCV together as predictors. The implication of this R^2 value is that these intrinsic properties may likely have significant influence on the perception, acceptance for and/or retention of woody species in agroforestry plots by the respondents in this study area.

The results in Table 3 showed that, statistically, SG significantly predicted CNV (P=0.05) in equation 1 while NCV did not significantly predict CNV (P=0.233) according to the results in Table 3. On subjecting the regression equation to ANOVA, the results showed that the predictive power of the equation is significant with 95% confidence (Table 4). The values obtained for R^2 for equation 1 was high enough for predictive purposes in this study, although statistically, NCV did not significantly predict CNV in equation 1.

It should be noted that if the correlation between any pair of independent variables is too high, the dependent variable in a multiple regression analysis might likely be poorly estimated or described as a result of problem of auto-correlation (Freese, 1964). In line with this, two different univariate regression equations of the type ($y = b_o + bx$) using SG and NCV alone (equations 2 and 3) were developed to ascertain if this problem exists.

$$\text{CNV} = 445 + 423\ \text{SG} \qquad \text{Equation 2}$$

$$\text{CNV} = 260 + 27.6\ \text{NCV} \qquad \text{Equation 3}$$

The R^2 values obtained for equations 2 and 3 in Tables 5 and 7, respectively, also had similar values compared with that of equation 1. The R^2 values showed that 75.70% represents the proportion of variation in the CNV explained by SG alone as a predictor, while 67.7% was the proportion of variation in the CNV explained by NCV in this study.

The results imply that SG and NCV are correlated as also noted by Erakhrumen, (2006), and this might likely be the reason why NCV did not significantly predict CNV in equation 1 as a result of likely auto-correlation between SG and NCV, while the reverse was the case in equation 3 where NCV predicted CNV. This might also explain why R^2 was not significantly better when both SG and NCV are put in the regression model depicted by equation 1 when compared with univariate regression equations 2 and 3. Nevertheless, the results obtained for the three equations reinforced and supported the works by Erakhrumen, (2006; 2008a; 2009).

The ratio of the corresponding value under coefficient and its standard error coefficient of the constant and SG and NCV known as the T-value showed that SG and NCV singularly significantly predicts the CNV in this study since the calculated values were greater than the pre-selected α-level of 0.05 (Table 5 and 7). On subjecting the regression equations 2 and 3 to ANOVA, the results showed that the predictive power of the equations was significant with 95 % confidence (Table 6 and 8).

These results showed that SG and NCV of wood species in this study area and perhaps in others can be used as a likely indication of their being accepted for agroforestry. It is important to note that the earlier stated factors and others not investigated in this study are likely to influence predictive power of these kinds of equation stated above in different localities.

5 CONCLUSION
5. ZAKLJUČAK

The outcome of this study supports the idea that stakeholders will have to work together as a team for achieving a successful and sustainable renewable natural resource system of production. Results of this research have also shown that one of the reasons why woody species are either selected and/or retained in agroforestry land use pattern is their potential usefulness as fuelwood and they will prefer high density wood particularly those with high energy density for this purpose. It is therefore recommended, based on the outcome of this study, that when woody species are to be selected for incorporation and/or retention in agroforestry schemes or plots, properties to be considered should include high SG and wood energy value, since these properties are observed to either directly or indirectly influence this choice in this study area.

Acknowledgement - Zahvala

The author acknowledges the funding support from the African Academy of Sciences (AAS)/African Forest Research Network (AFORNET), Nairobi, Kenya, for the project titled "*Wood Energy Value as a Factor of Species Selectivity in Agroforestry in Selected Local Government Areas of Oyo State, Nigeria*" and the permission to publish scientific articles from it.

6 REFERENCES
6. LITERATURA

1. Akachuku, A.E. 1980: Wood density of *Gmelina arborea* (Roxb.) and its Biological basis. *Agric. Research Bulletin*, 1(2): 29 pp.
2. Bada, S.O. 1990: The Influence of Forest Management on the Wood Quality of a Native Species. *Journal of Tropical Forest Resources*, 5&6: 54-61.
3. Barnes, D.F.; Floor, W.M. 1996: Rural Energy in Developing Countries: A Challenge for Economic Development. Annu. *Rev. Energy Environ.*, 21: 497-530.
4. Deibold, J.P.; Bridgwater, A.V. 1997: Overview of fast Pyrolysis of Biomass for the Production of Liquid Fuels. *Development in Thermochemical Biomass Conversion*, 1:5–24.
5. Diaz, L.F.; Golueke, C.G. 1981: Residues and Wastes. In: Sofer, S.S and Zabrosky, O.R. (Eds.) *Biomass Conversion Process for Energy and Fuels*. Plenum Press, New York. pp. 103-112.
6. Erakhrumen, A.A. 2005: Wood Energy Value as a Factor of Species Selectivity in Agroforestry in Selected Local Government Areas of Oyo State, Nigeria. Unpublished M.Sc. Dissertation, Department of Forest Resources Management, University of Ibadan, Ibadan, Nigeria. 87 pp.
7. Erakhrumen, A.A. 2006: Predicting Net Calorific Value from Specific Gravity of Fuelwood Species from Agroforestry Plots in Southwestern Nigeria. *The Nigeria Journal of Forestry*, 36 (1): 61-70.
8. Erakhrumen, A.A. 2007: Overview of Various Biomass Energy Conversion Routes. *American-Eurasian Journal of Agricultural & Environmental Sciences*, 2 (6): 662-671.
9. Erakhrumen, A.A. 2008a: Influence of Specific Gravity on Wood Species Selection for Agroforestry in some Local Government Areas of Oyo State, Nigeria. *African Journal of Agricultural Research*, 3 (2): 134-139.
10. Erakhrumen, A.A. 2008b: Wood Biomass as a Major Source of Energy in Sub-Sahara African Region: Implications for Sustained Research and Education in Agroforestry Technologies. In: Onyekwelu, J.C., Adekunle, V.A.J. and Oke, D.O. (Eds.) Research for Development in Forestry, Forest Products and Natural Resources Management. Proceedings of the First National Conference of the Forests and Forest Products Society of Nigeria held at the Federal University of Technology, Akure, Ondo State, Nigeria, from the 16th to 18th of April 2008. pp. 205-211.
11. Erakhrumen, A.A. 2009: Energy Value as a Factor of Agroforestry Wood Species Selectivity in Akinyele and Ido Local Government Areas of Oyo State, Nigeria. *Biomass & Bionergy*, 33 (10): 1428-1434.
12. Erakhrumen, A.A.; Ogunsanwo, O.Y. 2005: Women as Major Stakeholders in Sustainable Agroforestry Fuelwood Development. In: Popoola, L., Mfon, P. and Oni, P.I. (Eds.) Sustainable Forest Management in Nigeria: Lessons and Prospects. Proceedings of the 30th Annual Conference of the Forestry Association of Nigeria held in Kaduna, Kaduna State, Nigeria from the 07th to 11th of November 2005. pp. 631-639.
13. Espinoza, J.A. 2004. Within-tree density gradient in *Gmelina arborea* in Venezuela. *New Forest*, 28: 302-307.
14. Foley, G. 1986: Charcoal making in Developing Countries. Technical Report No. 5. Earthscan 1986. Published by International Institute for Environment and Development (IIED). 214 pp.
15. Freese, A. 1964: *Linear Regression Methods for Research*. U.S.D.A. For. Ses. Res. Pap. FPS 17, 136pp.
16. Groves, K.W.; Chivuya, A.M. 1989. Fuelwood Evaluation of Four Australian Grown Tree Species. In: Boland, D.J. (Ed.) Trees for the Tropics: Growing Australian multipurpose Trees and Shrubs in Developing Countries. *ACIAR Monograph*, 10: 159-169.
17. Hakkila, P. 1984: Polttohakepuun kuivuminen metsassa. Summary: Forest Seasoning of Wood intended for Fuel Chips. *Communicationes Instituti Forestalis Fenniae*, 54(4):82.
18. Hall, D.O.; deGroot, P.J. 1987: Introduction: The Biomass Framework. In: Hall, D.O. and Overend, R.P. (Eds.) Biomass Renewable Energy. John Wiley & Sons Ltd. pp. 3-24.
19. Harker, A.P.; Sandels, A.; Burley, J. 1982: Calorific Values of Wood and Bark and Bibliography of Fuelwood.

Published by Tropical Products Institute, London, U.K G 162. 20 pp.
20. Ince, P.J. 1977: Estimating effective Heating Value of Wood or Bark Fuels at various Moisture Contents. USDA Forest Service General Technical Report, EPL-13, Washington, DC.
21. Jain, R.K. 1994: Fuelwood Characteristics of Medium Tree and Shrub Species of India. *Bioresource Technology*, 47: 81-84.
22. Johansson, T.B.; Kelly, H.; Reddy A.K.N.; Williams, R.H. 1993: A Renewable Intensive Global Energy Scenario. In: Johansson, T.B., Kelly, H., Reddy, A.K.N. and Williams, R.H. (Eds.) Renewable Energy: Sources for Fuels and Electricity. Washington, DC: Island. pp. 1071-1140.
23. Kataki, R.; Konwer, D. 2002: Fuelwood Characteristics of Indigenous Tree Species of North-East India. *Biomass & Bioenergy*, 22: 433–437.
24. Kio, P.R.O. 2002: Community Forestry for Sustainable Forest Development. In: Popoola, L. (Ed.) Forests, People and Environment. Proceedings of a National Workshop Organised by FANCONSULT and Edo State Chapter of Forestry Association of Nigeria held in Benin City, Edo State, Nigeria from 5th to 6th September, 2002. pp. 15-26.
25. Klasnja, B.; Kopitovic, S.; Orlovic, S. 2002: Wood and Bark of some Poplar and Willow clones as Fuelwood. *Biomass & Bioenergy*, 23: 427-432.
26. Ladipo, D.O.; Adebisi, A.A.; Adewusi, H.G. 2002: Domestic Energy and Conservation Needs for Indigenous Forest Species in Nigeria. In: Abu, J.E., Oni, P.I. and Popoola, L. (Eds.) Forestry and Challenges of Sustainable Livelihood. Proceedings of the 28th Annual Conference of the Forestry Association of Nigeria held in Akure, Ondo State, Nigeria from 4th – 8th November, 2002. pp. 22-29.
27. Larson, P.R.; Kretschmann, D.E.; Clark, III A.; Isebrands, J.G. 2001: Formation and properties of juvenile wood in southern pines: a synopsis. Gen. Tech. Rep. FPL-GTR-129. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 42 pp.
28. Leach, G. 1992: The Energy in Transition. *Energy Policy*, 20: 117-123.
29. Lemenih, M.; Bekele, T. 2004. Effect of Age on Calorific Value and Some Mechanical Properties of three Eucalyptus Species grown in Ethiopia. *Biomass & Bioenergy*, 27: 223-232.
30. Lucas, E.B.; Fuwape, J.A. 1984: Burning and Related Characteristics of Forty-two Nigerian Fuelwood Species. *The Nigerian Journal of Forestry*, 14(1&2): 45-52.
31. Mahlako, C. 1993: Farmer to Farmer: Rural People's Role in Generating and Disseminating Agroforestry Technology and some Participatory Approaches to Agroforestry Extension. AERDD, University of Reading *Rural Extension Bulletin*, 2: 18-22.
32. Murphy, W.K.; Cutter, B.E. 1974: Gross Heat of Combustion of Five Hardwood Species of Different Moisture Content. *Forest Products Journal*, 24: 44-45.
33. Ogunsanwo, O.Y.; Erakhrumen, A.A. 2006: Gender Influence on Firewood Sourcing for Income Generation in Selected Rural Communities of Oyo State, Nigeria. *Journal of Tropical Forest Resources*, 22 (1): 76-84.
34. Ogunsanwo, O.Y.; Erakhrumen, A.A.; Otorokpo, A. 2008: Energy Value of Selected Parts of *Peltophorum pterocarpum* (D.C.) Backer ex K. Heyne: An Avenue Tree in the University of Ibadan Campus, Ibadan, Nigeria. *OBECHE*, 26 (1): 78-85.
35. Ogunsanwo, O.Y.; Onilude, M.A. 2000: Specific Gravity and Shrinkage Variations in Plantation grown Obeche *Triplochiton scleroxylon* K. Schum. *Journal of Tropical Forest Resources*, 16 (1): 39-44.
36. Oluwadare, A.O.; Omole, A.O. 1999: Fuel Value of *Senna siamea* (Lam.) and its Potential for Protective Forestry. In: Obiaga, P.C., Abu, J.E., Popoola, L. and Ujor, G. (Eds.) Conservation of Nigeria's Natural Resources and the Threatened Environment. Proceedings of the 26th Annual Conference of the Forestry Association of Nigeria held in Maiduguri, Borno State, Nigeria from 19th – 23rd April, 1999. pp. 162-168.
37. Packham, R.G. 2001: Background and Application of Participative Approaches. In: Application of Participatory Approaches to Sustainable Rural Resource Management and Environmental Conservation in Asian-Pacific Countries. Proceedings of annual Tsukuba Asian Seminar on Agricultural Education. pp. 19-33.
38. Panshin, A.J; deZeeuw, C. 1980: *Textbook of Wood Technology*. 4th Edition. New York, McGraw-Hill. 722 pp.
39. Panshin, A.J.; Harrar, E.S.; Bethel, J.S.; Baker, W.J. 1962: *Forest Products*. 2nd Edition. McGraw Hill Books Co. Inc. New York. 538 pp.
40. Popoola, L.; Adeola, A.O.; Aiyelaagbe, I.O.O.; Ladipo, D.O. 1996: Farmers' Priority Multipurpose Tree and Shrub Species for Agroforestry in the Humid Lowlands of Nigeria. *Journal of Tropical Forest Resources*, 12: 16-31.
41. Puri, S.; Singh, S.; Bhushan, B. 1994: Evaluation of Fuelwood Quality of Indigenous and Exotic Tree Species of India's Semiarid Region. *Agroforestry Systems*, 26: 123-130.
42. Rogers, E.M. 1983: *Diffusion of Innovations.* 3rd Edition, Free Press, Glencoe, Ill., USA.
43. Senelwa, K.; Sims, R.E.H. 1999: Fuel Characteristics of Short Rotation Forest Biomass. *Biomass & Bioenergy*, 17: 127-140.
44. Shanavas, A. and Kumar, B.M. 2006. Physical and Mechanical Properties of three Agroforestry Tree Species from Kerala, India. *Journal of Tropical Agriculture*, 44 (1-2): 23-30.
45. Sheng, C.; Azevedo, J.L.T. 2005: Estimating the Higher Heating Value of Biomass Fuels from Basic Analysis Data. *Biomass & Bioenergy*, 28: 499-507.
46. Temu, A.B. 2002: African Forestry and Challenges of Sustainable Livelihood. In: Abu, J.E., Oni, P.I. and Popoola, L. (Eds.) Forestry and Challenges of Sustainable Livelihood. Proceedings of the 28th Annual Conference of the Forestry Association of Nigeria held in Akure, Ondo State, Nigeria from the 4th to 8th November, 2002. pp. 1-10.
47. Tillman, D.A. 1978: Wood as an Energy Resource. Academic Press, New York, 252 pp.
48. Twidell, J. 1998: Biomass Energy, Renewable Energy. *New Renewable Energy Resources*, 1(3): 38-39.
49. Vanclay, F.; Lawrence, G. 1994: Farmer Rationality and the Adoption of Environmentally Sound Practices: A critique of the Assumptions of Traditional Agricultural Extension. *European Journal of Agricultural Education and Extension*, 1(1): 59-90.
50. Wang, S.; Huffman, J.B.; Rockwood, D.L. 1989: Quantitative Evaluation of Fuelwood in Florida-A Summary Report. *Economic Botany*, 36(4): 381-388.
51. Zobel, B.J.; Jett, J.B. 1995: Genetics of Wood Production. Published by Springer Verlag, Berlin, Germany. 337 pp.

52. *** ASTM, 1984. ASTM D 4442-84 Standard Test Methods for Direct Moisture Content of Wood and Wood-base Materials. American Society for Testing and Materials. Vol. 04.09., 514-518.
53. ***ASTM, 1989. ASTM D 2395 – 89 Standard Test Methods for Measuring the Specific Gravity of Wood. Annual Book of ASTM Standards. American Society for Testing and Materials. Philadelphia.
54. *** FAO, 2001: The Role of Woodfuel in Africa by Gustafon, D. In: Wamukonye, N. (Ed.) Proceeding of a High Level Regional meeting on Energy and Sustainable Development. 10-13, January 2001. Nairobi, Kenya. pp. 99-101. Food and Agriculture Organization of the United Nations, Rome.
55. *** FAO, 2007: State of the World's Forests. Food and Agriculture Organization of the United Nations, Rome, 2007. xii + 144 pp.
56. ***Forest Service, 1994: Firewood from Victoria's Forests. Conservation & Natural Resources. 4 pp. http://www.recycledfuels.com.au/Content/firewood.pdf
57. ***Retrieved from the site on the 2nd of November 2005.
58. ***Forest Service, 1994: Firewood from Victoria's Forests. Conservation & Natural Resources. 4pp. Available at: http://www.recycledfuels.com.au/Content/firewood.pdf
59. ***Retrieved from the internet on the 2nd of November, 2005.
60. ***FPL, 1999: Wood Handbook—Wood as an Engineering Material. General Technical Report FPL–GTR–113. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 463 pp. Http://www.fpl. fs.fed.us/documnts/usda/ah188/chapter01.pdf
61. ***Retrieved from the site on the 2nd of November 2005.
62. ***FRIN, 1999. Agro-Climatology Data for FRIN Ibadan Weather Station. Forestry Research Institute of Nigeria, Ibadan, Nigeria, 1999.
63. ***ICRAF, 1983: International Council for Agroforestry. In: Huxley, P.A. (Ed.) *Plant Research and Agroforestry*. 617pp. Nairobi, Kenya.
64. ***ICRAF, 1991: Annual Report (1991). International Centre for Research in Agroforestry. 148pp.
65. ***IITA, 1993: IITA Weather Bulletin. International Institute of Tropical Agriculture, Ibadan, Nigeria.

Corresponding address:

Professor ANDREW A. ERAKHRUMEN, PhD

Department of Forest Resources Management
University of Ibadan
Ibadan, Nigeria
E-mail: erakhrumen@yahoo.com

Richard Vlosky[1], Tood Shupe, Qinglin Wu

Perceptions & Use of Termite Resistant Treated Wood Products in the United States. Part II: The Perspective of Home Builders and Architects in Formosan Subterranean Termite Infected States

Percepcija i uporaba drvnih proizvoda zaštićenih od termita. Dio II: Stajališta graditelja kuća i arhitekata u državama zaraženim podzemnim termitima iz porodice *Coptotermes*

Original scientific paper · Izvorni znanstveni rad
Received – prispjelo: 19. 3. 2009.
Accepted – prihvaćeno: 18. 11. 2009.
*UDK: 630*841; 630*845.3*

ABSTRACT • *This paper is Part II of a study that examines perceptions, attitudes and behaviors regarding termites and treated wood. In Part I, we surveyed homeowners and in this paper we surveyed home builders and architects. The geographic region for both Parts I and II is U.S. states where Formosan subterranean termites (FST) exist. This is a particularly voracious species of termite. Overall, in this paper, respondents are in agreement that treated wood is safe in new home construction framing and is safe if handled and disposed of properly. Forty-one percent of respondents agreed that treated wood is safe for residents in indoor structural applications. Overall, when taking into account the neutral responses, respondents have a favorable view of treated wood safety for all applications posed to them. Fifty-five percent of respondents were not familiar at all with FST. Although they had a general lack of knowledge, 29 percent of respondents said FST were a problem in the regions their companies serve.*

Keywords: *termites, United States, treated wood, home builders, architects*

[1] Authors are professors at Louisiana Forest Products Development Center, School of Renewable Natural Resources, Louisiana State University Agricultural Center, Baton Rouge, Louisiana.
[1] Autori su profesori u Centru za razvoj šumskih proizvoda, Školi za obnovljive prirodne resurse i Poljoprivrednom centru Sveučilišta u Louisiani, Baton Rouge, Louisiana.

SAŽETAK • *Ovaj rad drugi je dio studije koja proučava stajališta, mišljenja i ponašanja vezana za termite i zaštićeno drvo. U prvom radu anketirani su vlasnici kuća, dok su u ovom radu anketirani graditelji i arhitekti. U radu su, kao i u prvom dijelu istraživanja, proučavane američke regije u kojima je utvrđeno postojanje podzemnih termita iz porodice Coptotermes (FST). Spomenuti su termiti posebno agresivna vrsta termita. U cjelini, ispitanici smatraju da je zaštićeno drvo, uz pravilnu uporabu i rukovanje, sigurno za izgradnju kuća i novih konstrukcijskih elemenata. Pritom 51 % ispitanika smatra kako je zaštićeno drvo pri uporabi u unutarnjim uvjetima sigurno za ljude. Općenito, kada se uzmu u obzir i neutralni odgovori, ispitanici imaju pozitivno mišljenje o uporabi zaštićenog drva u svim ispitivanim uvjetima i situacijama. No 51 % ispitanika uopće nije informirano o podzemnom termitu (FTS). Iako većina ispitanika malo zna o podzemnim termitima, 29 % njih izjasnilo se kako su u regijama u kojima djeluju njihove tvrtke imali problema sa spomenutim termitima.*

Ključne riječi: *termiti, Sjedinjene Američke Države, drvni proizvodi, graditelji kuća, arhitekti*

1 INTRODUCTION
1. UVOD

The wood treating industry in the U.S. was an estimated to be $4.5 billion dollars in 2008 (Vlosky, 2009). Pressure treated wood has become an important commodity in U.S. markets with 50 million U.S. homeowners having pressure treated wood structures (Eisler, 2003).

Commercial wood preservatives have been broadly classified as either water based or oil-type depending on chemical composition of the preservative and the carrier used during the treatment process (USDA, 2005). All treatments in the liquid phase generally depend on movement of the liquid preservative into the wood (Freeman *et al*., 2003). Oil-type preservatives are further divided into oilborne preservatives and creosote and creosote solutions (Prestemon, 1994).

The volume of wood treated with copper based preservatives grew rapidly during the 1970s and 80s and remains high today (Freeman and McIntyre, 2008). Since the 1970's, the majority of the wood used in residential settings was CCA-treated wood (CPSC, 2005). Preservative-treated wood is economical, durable, and often aesthetically pleasing.

There has been a growing public concern regarding the safety of treated wood. In particular, the concern regarding disposal has heightened as a result of greater public awareness of potential dangers from arsenic that has been generated as a result of a recent U.S. Environmental Protection Agency (EPA) ruling that stated that the wood preservative industry has voluntarily decided to halt production of CCA-treated wood for consumer uses. In previous research conducted by the authors, consumers were found to have reservations about using treated wood in their homes. The perceptions of treated wood by the public may be the cause of a credibility problem for the wood industry. For example, in a 2001 study, only 27 percent of U.S homeowners indicated that they trust wood claims made by wood product suppliers (Vlosky and Shupe, 2002).

In recent years there has been renewed interest in wood durability in terms of residential housing. In the U.S., home builders and architects are primarily responsible for the majority of treated wood that is purchased for new home construction. The market place has become increasingly competitive as non-wood alternatives (i.e., steel and concrete) continue to gain market share by marketing a "non-toxic and uniform" product. However, these products continue to increase in price as the global demand for steel and concrete continues to rise. With regards to preservative-treated wood, there have been tremendous changes in the consumer market. Builders and architects are being forced to select from waterborne preservatives that they likely have less familiarity than CCA. Some of the preservatives such as alkaline copper quat (ACQ) and copper azole (CA), although viewed as "new," have been in use for a decade or more, primarily overseas. Many treaters are now using these preservatives rather than CCA. The three largest wood-preservative manufacturers in the U.S., Arch Wood Protection, Chemical Specialties, and Osmose, have been transitioning from CCA products to alternative, arsenic-free products. This new generation of preservatives—which includes Alkaline Copper Quartenary (ACQ) and Copper Azole (CBA)—makes use of organic copper-based formulas (BobVilla.com). Other alternative water-borne preservatives anticipated to increase in use include borates and sodium borates (SBX), copper HDO, and propiconazole-tebuconazole-imidacloprid (PTI). ACQ is the most widely used alternative currently being used in the United States exceeding usage of CCA in 2004 (Vlosky, 2006) but below CCA usage in 2007 (Vlosky, 2009).

Any treated wood preservative must be safe when used as directed. In addition, ecologically benign alternatives to traditional preservatives should be utilized if possible. Examples are organic-, nano-, and borate-based preservatives.

A previous study of home builder perceptions of preservative-treated wood found that that only one percent of respondents had an extremely negative perception of treated wood while 38 percent had a somewhat positive perception and 32 percent had an extremely positive perception (Vlosky and Shupe, 2004). Sixty-one percent of respondents felt that treated wood is safe for human in outdoor applications and it is safe if handled and disposed of properly. Fifty-one percent said it is safe for builders to use. Further, 42 percent believed it is safe for children's outdoor play equipment and 38 percent believed treated wood is safe for pets or farm animal exposure. Finally, 55 percent of respondents desired additional information on treated wood.

The study, conducted in 2007, addresses issues that U.S. home builders and architects consider in evaluating whether to build or specify homes that are built with termite resistant building materials. The objective of the study was to identify the factors that affect potential usage of termite resistant structural panels and other treated wood products in the region of the United States that is impacted by the Formosan subterranean termite. We examined the perspectives of home builders and architects to better understand: 1) Basic understanding of the treated wood market space; 2) Incentives for usage; 3) Barriers and concerns that may preclude usage; 4) Willingness-to-pay for termite resistant wood products and; 5) Identify market potential for termite resistant structural panels and other treated wood products.

2 MATERIALS AND METHODS
2. MATERIJALI I METODE

2.1 Research procedures
2.1. Postupci istraživanja

Mailed questionnaires were used to conduct the study. This method is a cost-effective means of data collection and affords a high degree of anonymity. Mail surveys are also less limited by rigid time constraints that can impede the effectiveness of other survey methods. Sampling, survey procedures, follow-up efforts and data analysis were conducted in accordance with well-documented and verified mail survey techniques. The following sections elaborate on these procedures.

Based on an iterative process with study clients, a list of topics and questions were generated. The survey was reviewed and revised by the researchers and study clients. In addition, a pre-test sample was conducted with 30 companies randomly selected from the sample pools to check for readability and clarity. An iterative process resulted in the final questionnaire. Survey recipients were provided with the following definition of Treated Wood: "Wood in which preservatives have been added to improve resistance to termites and decay."

2.2 Sampling
2.2. Uzimanje uzoraka

Sample frames for the study consisted of a random sample of the top 250 home builders and top 250 architectural firms in the study region (by 2006 sales). The study region included states where Formosan subterranean termites currently exist (Ring, 2005) as well as selected states on the periphery. Mailing lists were purchased from Best Mailing Lists, Inc., a national list provider. All survey recipients were identified by name (and title for companies).

2.3 Data analysis
2.3. Analiza podataka

Questionnaire quantitative data was coded and entered into the Statistical Package for the Social Sciences (SPSS)® for analysis and interpretation. Data entry was closely supervised to ensure accuracy. Descriptive and frequency statistics were generated for the quantitative data; qualitative information from open-ended questions was analyzed to discern common themes or concepts. After accounting for undeliverable surveys and recipient requests to be removed from the mailing list, the adjusted response rate was 34 percent.

3 RESULTS
3. REZULTATI

Of the 130 respondents in this study, 111 (85 percent) are from the home building industry and 19 (15 percent) represent architectural firms. Of the 74 questions in the survey where response comparisons can be made between home builders and architects, there were statistical differences in 10 questions. Along with the result that architects make up only 15 percent of total responses, the two groups were combined for reporting purposes.

3.1 Demographics
3.1. Demografske strukture

Over two-thirds of respondents are in 6 of the 15 states included in the study (Table 1). Alabama and Florida each account for 15 percent of responses. With regard to company size, all respondents combined had an average of about $33 million in sales in 2006. Figure 1 shows the distribution of respondent sales. Although the largest 500 firms were surveyed, nearly half of respondents had sales between $1 million and $19 million in 2006. On the other end of the spectrum, the study did capture large firms with 22 percent of respondents having 2006 sales of $80 million to $100 million or more. The pattern is similar with regard to number of full-time employees with nearly 50 percent of respondents having between 11 and 50 employees (Figure 2). Twenty-three percent of respondents have over 100 employees.

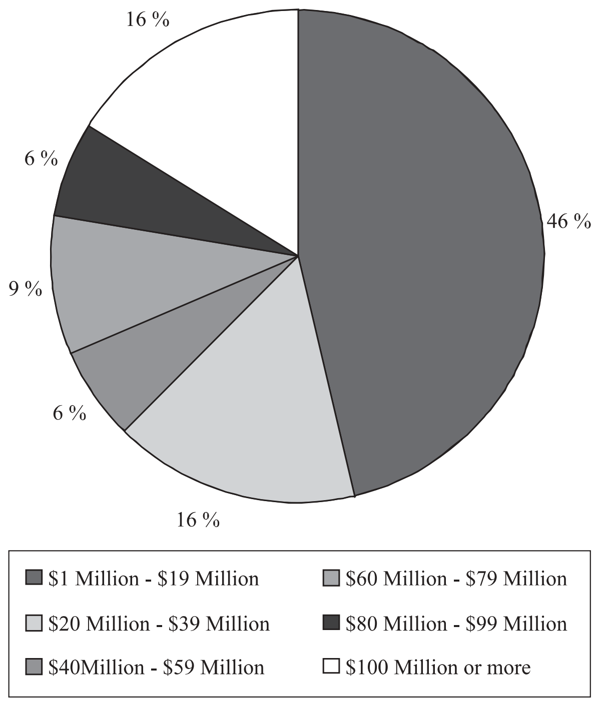


Figure 1. Respondent sales in 2006 (*n* = 130)
Slika 1. Prodaja među ispitanicima u 2006. godini (*n* = 130)

Table 1 Respondents by state
Tablica 1. Ispitanici prema državama

State / *Država*	**Frequency** / *učestalost*	**Percent** / *postotak*	**Cumulative percent** / *Prosječni postotak*
Alabama	20	15.4	15.4
Florida	19	14.6	30.0
Texas	17	13.1	43.1
California	16	12.3	55.4
Louisiana	10	7.7	63.1
Kentucky	8	6.2	69.2
Georgia	7	5.4	74.6
South Carolina	6	4.6	79.2
Mississippi	5	3.8	83.1
Virginia	5	3.8	86.9
Arkansas	4	3.1	90.0
Arizona	3	2.3	92.3
Hawaii	3	2.3	94.6
Maryland	3	2.3	96.9
Delaware	2	1.5	98.5
North Carolina	2	1.5	100.0%
Total / *ukupno*	130	100.0%	

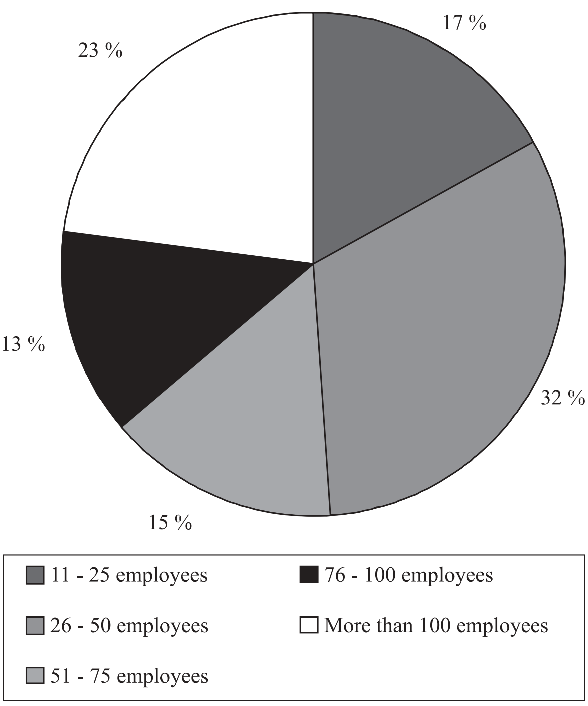


Figure 2 Number of employees in respondent companies (n = 130)
Slika 2. Broj osoba zaposlenih u istraživanim tvrtkama (n = 130)

3.2 Building materials and construction
3.2. Građevni materijali i konstrukcija

Respondents were asked to indicate the importance of the different construction criteria they use when building/specifying a new house. A scale of 1=very unimportant to 3=neutral to 5=very important was used. Figure 3 shows the rank of these criteria by mean importance. Of note to the treating industry is that the two highest ranked criteria are treated-wood-related, to be free from mold and resistant to decay. Additional points to note are that resistance to wood destroying insects was ranked 6th.

Durability is an important concern for any building material a home builder might use or an architect might specify. Accordingly, we asked about the perception that respondents have about the number of years different competing materials would last in unexposed structural home applications (Figure 4). The choices were on a scale of: 1=0-10 years; 2=11-25 years and; 3=more than 25 years. Concrete (3.0) and steel (2.9) were ranked as having the greatest longevity. Treated lumber was ranked third (2.6).

3.3 Treated wood products
3.3. Zaštićeni drvni proizvodi

As the questionnaire transitioned into treated wood-related questions, we first wanted to see if respondents were familiar with the concept of treated wood and various chemicals and compounds used in wood preservation. In order to make comparisons to previous studies mentioned earlier, the choice set for preservatives used did not include trade names nor were all preservative names spelled fully. In addition, in this section, we were interested in general familiarity with preservatives and not specifically those with high efficacy in termite prevention. Sixty-one percent of respondents somewhat or strongly agreed that they were familiar with the overall concept of treated wood. Respondents were most familiar with creosote (72 percent of respondents) and chro-

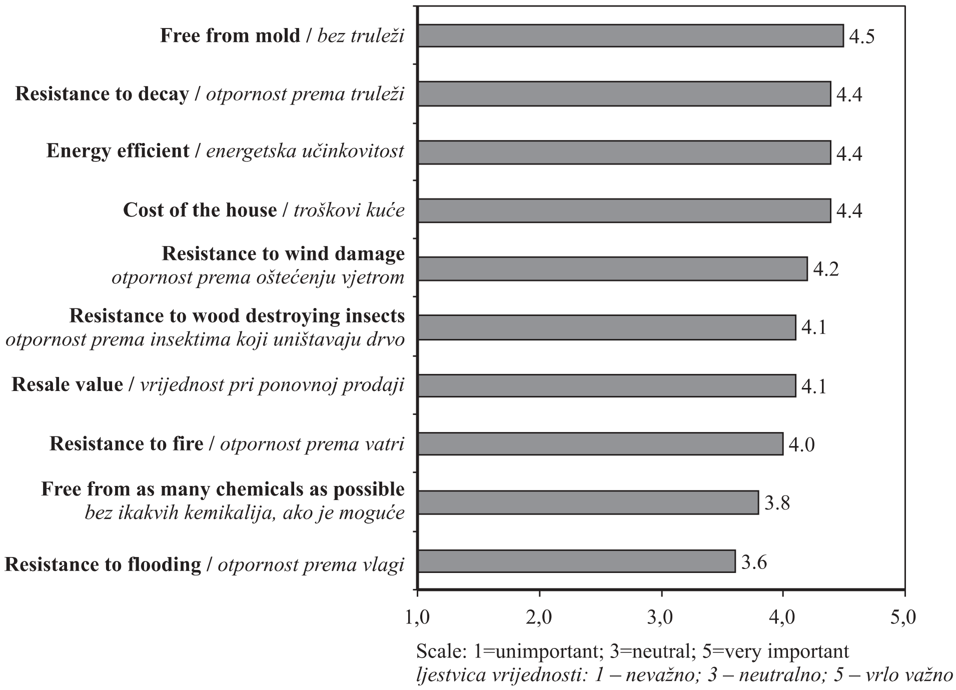


Figure 3 Importance of construction criteria (n = 128)
Slika 3. Važnost konstrukcijskih kriterija (n = 128)

mated copper arsenate (CCA) (71 percent) (Figure 5). Respondents were asked if they used or specified treated wood products for applications in homes they have built or specified (Figure 6). Decks and outside stairs were most cited with 84 percent of respondents. Outdoor structures and landscaping timbers followed with 68 percent and 65 percent of respondents, respectively. Other Products included those in contact with concrete, base plates, below grade forming and sheathing, boat docks, seawalls, sill plates and treated mud sills.

In 2002, a U.S. Environmental Protection Agency (EPA) ruling that stated that the wood preservative industry has voluntarily decided to halt production of CCA-treated wood for consumer uses (EPA, 2002). In previous research conducted by the authors, consumers were found to have reservations about using treated wood in their homes (Vlosky and Shupe, 2002). The perceptions of treated wood by the public may be the cause of a credibility problem for the wood industry. For example, in the same study, 27 percent of U.S homeowner respondents indicated that they trust wood claims made by wood product suppliers (Vlosky and Shupe, 2002). The ruling does not affect CCA treated structures for non-consumer uses such as poles, posts, crossties, etc. Also, the ruling does not require that existing CCA structures be removed or indicate that there

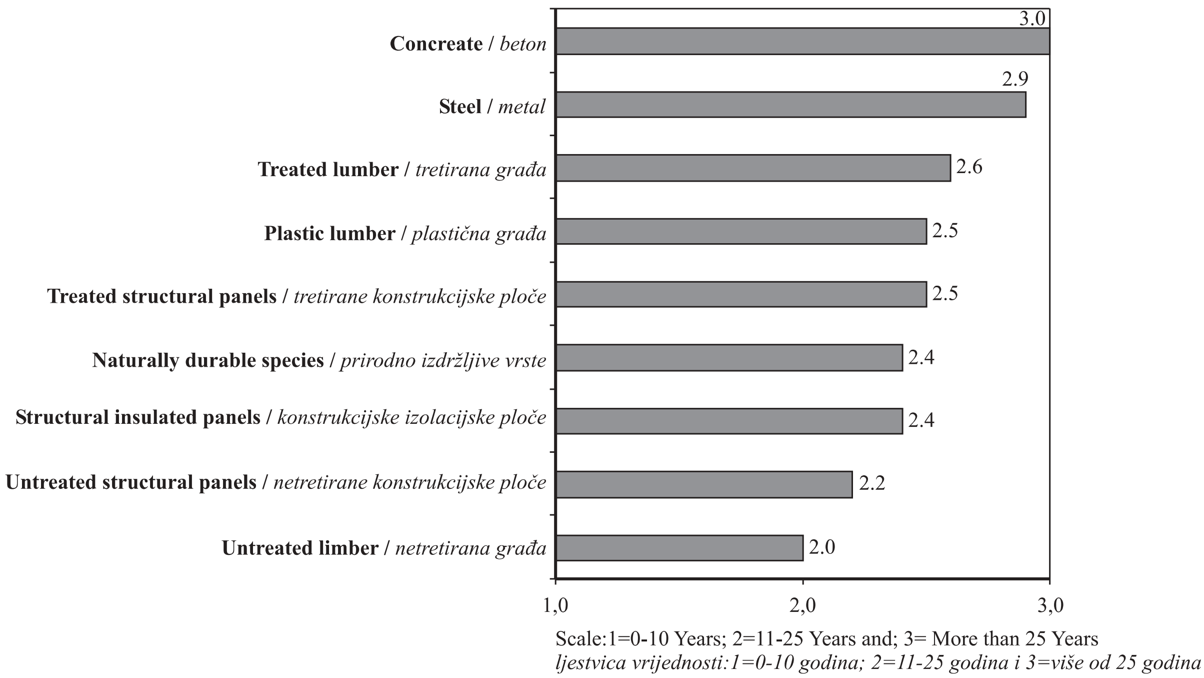


Figure 4 Perceived durability of building materials (n = 130)
Slika 4. Uočena trajnost građevnih materijala (n = 130)

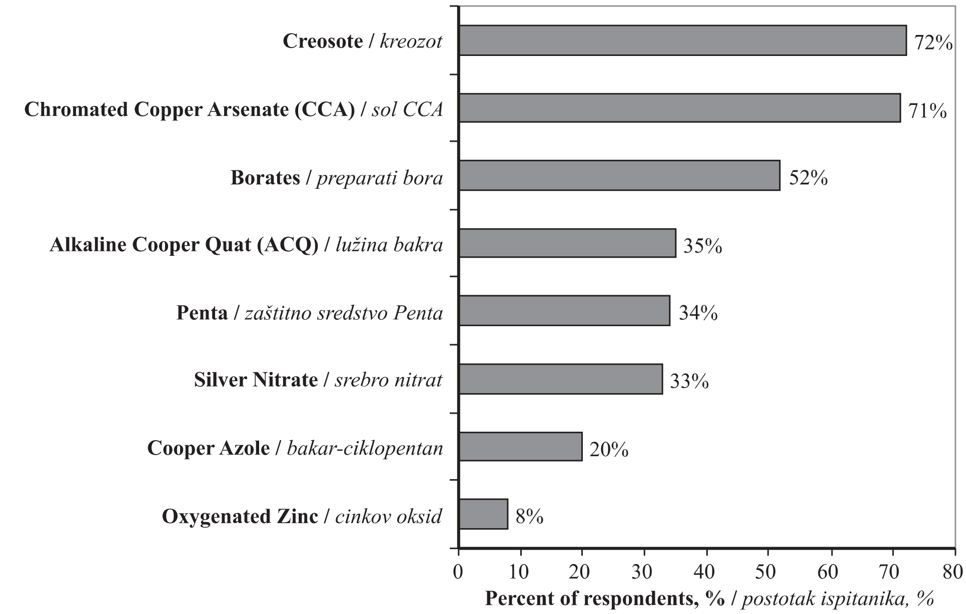


Figure 5 Familiarity with wood treating chemicals (n = 130) (multiple responses possible)
Slika 5. Poznavanje sredstava za zaštitu drva (n = 130) (mogućnost višestrukog odgovora)

are any adverse human health effects from exposure to existing CCA treated structures. Respondents in this study were asked how familiar they were with details of this transition. Nearly 25 percent were not aware at all while only 17 percent said they were very aware. We asked respondents what effect they expected in the marketplace from the switch to "new generation" preservatives. Forty-two percent said they did not know what effect this would have. On a 5-point scale from "Very Negative to "Very Positive", no respondents thought the effect would be "Very Negative" while nine percent thought the effect on markets would be "Very Positive". Twenty-six percent of respondents were at the midpoint (neutral).

As indicated previously, treated wood safety is an issue for consumers. Using a 5-point scale, we asked respondents to indicate their level of agreement or disagreement with statements regarding treated wood application safety. The results in Table 2 are ranked with the strongest level of agreement (somewhat agree + strongly agree) at the top. Overall, respondents are in agreement that treated wood is safe in new home construction framing and is safe if handled and disposed of properly. Forty-one percent of respondents agreed that treated wood is safe for residents in indoor structural applications. Overall, when taking into account the neutral responses, respondents have a favorable view of treated wood safety for all applications posed to them.

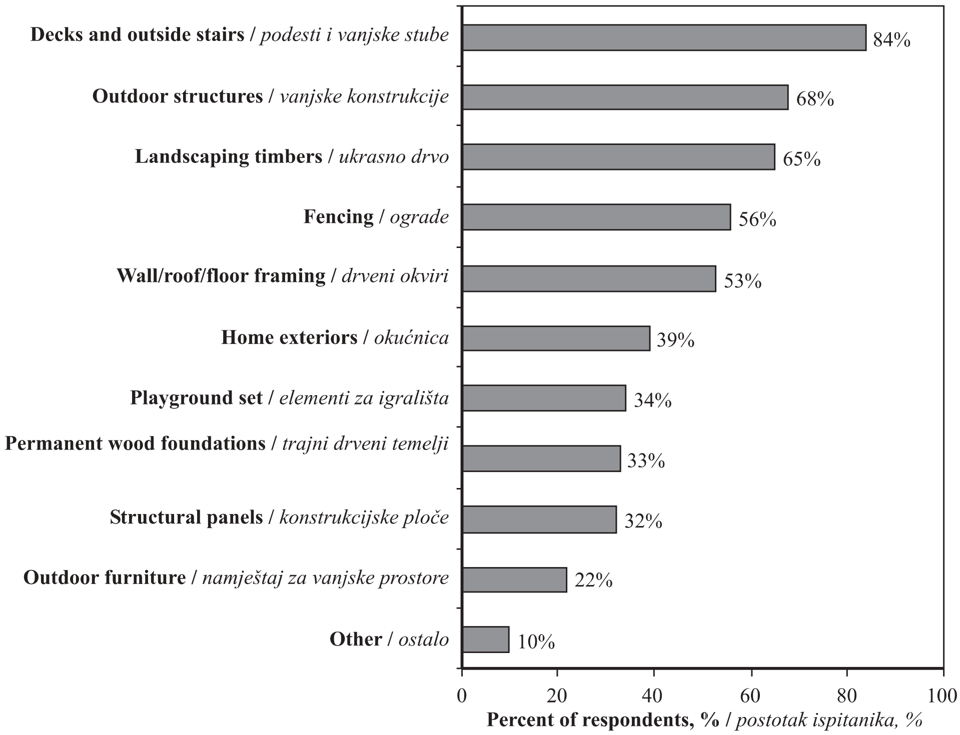


Figure 6 Treated wood applications used by respondents (n = 128) (multiple responses possible)
Slika 6. Udio zaštićenog drva što ga upotrebljavaju ispitanici (n = 128) (mogućnost višestrukog odgovora)

Table 2 Treated wood safety for selected application (n = 130)
Tablica 2. Sigurnost zaštićenog drva za određenu primjenu (n = 130)

	Strongly disagree *Ne slažem se u potpunosti*	**Somewhat disagree** *Djelomično se ne slažem*	**Neutral** *Neutralno*	**Somewhat agree** *Djelomično se slažem*	**Strongly agree** *Potpuno se slažem*
Is an acceptable material to use for new home construction framing *Materijal prihvatljiv za izradu konstrukcijskih okvira*	4%	4%	33%	30%	29%
Entirely safe with proper use, handling and disposal *Potpuno siguran uz pravilnu uporabu, rukovanje i odlaganje*	0%	13%	20%	46%	21%
Safe for outdoor human contact applications *Siguran za ljudski kontakt u vanjskim uvjetima*	1%	15%	26%	38%	20%
Safe to builders *Siguran za građevinske djelatnike*	1%	20%	21%	42%	16%
Safe to children for outdoor play equipment *Siguran za djecu i opremu za igranje u vanjskim uvjetima*	16%	28%	15%	29%	12%
Does not emit odors *Ne ispušta mirise*	2%	37%	35%	14%	12%
Safe to be near pets or farm animals *Siguran za kućne ljubimce i životinje*	7%	32%	24%	27%	10%
Safe to residents for indoor structural applications *Siguran za osobe pri uporabi u unutarnjim uvjetima*	9%	20%	30%	32%	9%

Respondents were asked if they thought that some types of treated wood are safer than others. Thirty-five percent of respondents said yes, 14 percent said no and 55 percent were not sure. This clearly indicates the need to educate home builders and architects regarding different preservative treatments and associated applications. The types of treated wood respondents think are MOST safe are ACQ and Borates while the types of treated wood they think are LEAST safe are CCA, Creosote and Penta.

How respondents form opinions about treated wood has implications for advertising and product promotion as well as venues to create awareness for home builders and architects. Word of mouth from other builders and architects was ranked first by 54 percent of respondents (Figure 7). Second ranked by 38 percent of respondents was Trade Magazines which indicates that this venue should be used by treated wood and preservative treatment manufacturers. Fifty-three percent of respondents said that they would like more information on proper use, handling and disposal of treated wood. This presents another opportunity for treated wood manufacturers and preservative providers to educate builders and architects on the benefits of using treated wood.

3.4 Termites
3.4. Termiti

Termite problems and issues are prevalent in many parts of the U.S. In the study region, the Formosan subterranean termite is particularly insidious. Surprisingly, 55 percent of respondents were not familiar at all with Formosan subterranean termites. Although they had a general lack of knowledge, 29 percent of respondents said Formosan subterranean termites were a problem in the regions their companies serve. When examined by state, 100 percent of respondents in Hawaii said Formosan subterranean termite Formosan subterranean termites were a problem (Figure 8). Hawaii was followed by South Carolina (83 percent of respondents said it was a problem) and Florida (79 percent). Georgia was represented by the smallest percent of respondents (9 percent).

Previously, we talked about building materials in the context of durability. In this section we asked respondents specifically about the efficacy of different building and construction materials protection against termites in general. As shown in Figure 9, using a 3-point scale of protection against termites, steel and concrete were ranked highest (both 2.9 /3.0). Treated wood and plastic were tied for second (2.6 / 3.0). Thirty-five percent of respondent said that they have had at least one experience with termites damaging a home they built remodeled or specified. Of these respondents, 68 percent said that they did not know what types of termit

Seventy-eight of respondents has taken some type of action to prevent attack by the termites in homes they build/specify. Figure 10 shows the actions that respondents have taken. The use of treated wood was the most cited (58 percent of respondents) followed by the use of soil termiticides (49 percent of respondents) and use of concrete (34 percent).

One of the objectives of the study was to get some idea of the demand for termite protection which, in turn, leads to a proxy for opportunities for treated wood products to meet this demand. Accordingly, we first asked respondents what is the *current level of demand*

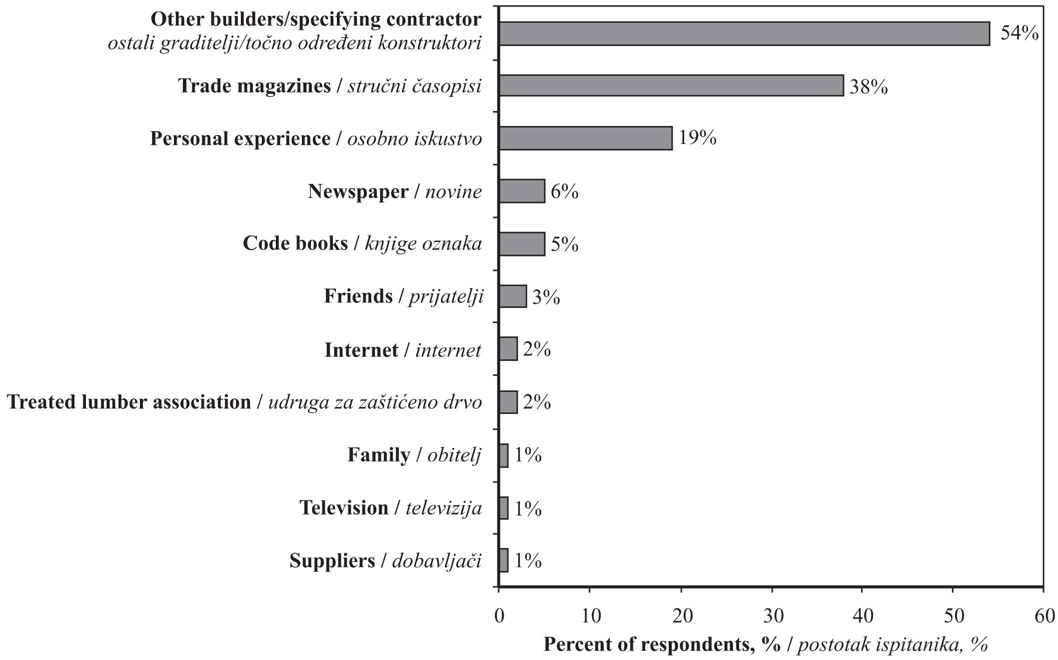


Figure 7 How respondents form opinions about treated wood (n = 119) (multiple responses possible)
Slika 7. Izvori na temelju kojih ispitanici stvaraju svoje mišljenje o zaštićenom drvu (n = 119) (mogućnost višestrukog odgovora)

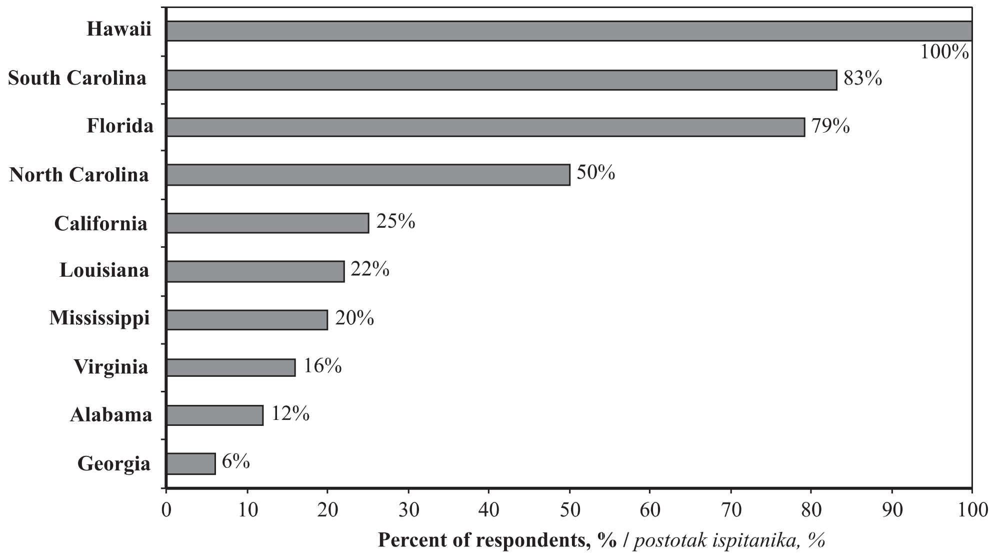


Figure 8 Formosan subterranean termite problems by State
Slika 8. Problemi uzrokovani podzemnim termitima u promatranim državama

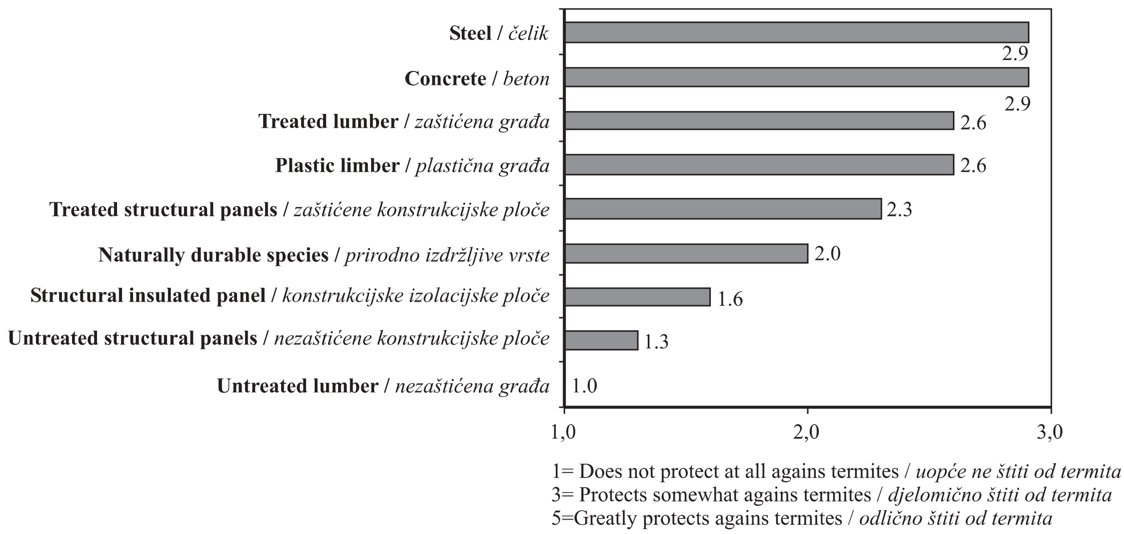


Figure 9 Building materials protection against termites (n = 129)
Slika 9. Zaštita građevnog materijala od termita (n = 129)

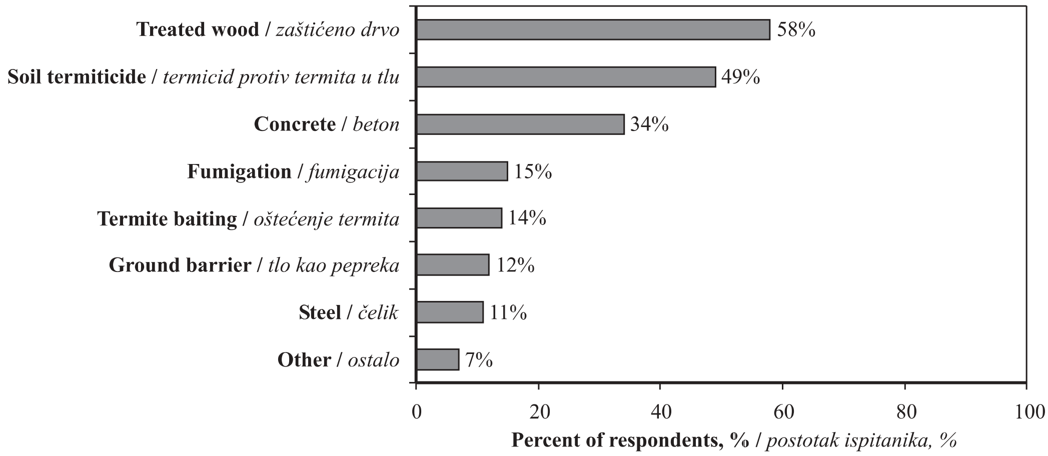


Figure 10 Actions taken to prevent termite attack (*n* = 130) (multiple responses possible)
Slika 10. Postupci za sprečavanje napada termita (*n* = 130) (mogućnost višestrukog odgovora)

that they see in the marketplace for termite prevention. Ten percent of respondents said that demand was extremely high and 28 percent feel demand is somewhat high. On the other end of the scale, 15 percent said demand is extremely low and an additional 23 percent sad demand is somewhat low. The remaining 25 percent said demand was neither high nor low.

The second question asked what they felt is the *trend in demand* in the marketplace for termite prevention in the future. Only 1 percent of respondents think demand will decline while 10 percent say demand will increase significantly and 35 percent think demand will increase somewhat. Twenty-five percent say demand will remain flat.

In an attempt to get a perspective on the cost premium the market places on termite prevention, we asked respondents how much of a premium they thought their customers would pay for an assured termite-free new home for 10 years over a home that does not carry this guarantee. For this exercise, a house was hypothetically priced at $80,000 USD (Table 3). Twenty-five percent of respondents said they did not think that their customers would pay any premium for a termite-free house. Sixty-three percent of respondents believe that customers will pay a premium between 2.5 percent-5 percent and 13 percent of respondents think their customers would pay a premium of 7.5 percent or more.

4 DISCUSSION AND CONCLUSION
4. DISKUSIJA I ZAKLJUČAK

In this paper, we present findings of a primary research study intended to identify experiences, awareness, perceptions, and behaviors regarding treated wood and termites from the perspective of home builders and architects in the United States. The scope of this research did not include a comparative analysis of responses to studies that may have been conducted in the literature.

Durability is an important concern for any building material a home builder might use or an architect might specify. Respondents indicated that two highest ranked criteria they use when building/specifying a new house are treated-wood-related; to be free from mold and to be resistant to decay. These data suggest that the wood preserving industry should continue to strive to produce products that have the highest degree of decay and mold resistance possible. This will be a competitive advantage for those treaters and preservative manufacturers that are first to market with these types of products.

An additional observation is that 61 percent of respondents "somewhat agree" or "strongly agree" that they were familiar with the overall concept of treated wood. This indicates that treated wood is at least positioned in builder and architect respondents' minds as an existing product. It does not necessarily infer any other perceptual characteristics about treated wood. However, with regard to durability, resistance to decay, and resistance to termites, concrete and steel both ranked higher than treated wood. This offers an opportunity for these two competing building material sectors to potentially capitalize on these perceptions to penetrate markets or increase market share. An apparent anomaly that bears further research is that treated wood was the

Table 3 Respondent customer willingness to pay a premium for a termite-free new home (*n* = 130)
Tablica 3. Spremnost ispitanika na plaćanje premije za kuću bez termita (*n* = 130)

	For a 10-year termite free home I think my customers would pay *Iznos koji su potrošači spremni platiti za 10-godišnje rezdoblje bez termita*						
Percent premium *Postotak premije*	0%	2.5%	5.0%	7.5%	10.0%	12.5%	More than *više od* 12.5%
House cost *Troškovi kuće*	$80,000	$82,000	$84,000	$86,000	$88,000	$90,000	More than *više od* $90,000
Percent of respondents *Postotak ispitanika*	25%	36%	27%	7%	4%	0%	2%

material used most by respondents to combat termites. Concrete was ranked third and steel was ranked seventh. This may be due to cost or aesthetic issues.

Respondents were most familiar with creosote and chromated copper arsenate (CCA) but these two preservatives are perceived to be among the least safe. A passing observation is that respondents seem to be most familiar with the least safe preservatives rather than with the most safe preservatives. This may have implications for the treating industry to a) reduce negative perceptions for CCA and creosote while promoting safer (perceived) preservatives.

Overall, treated wood products appear to be well entrenched in applications used by respondents. Decks, outdoor stairs, and landscaping timbers were among the applications built or specified most. As the market for new home construction fluctuates due to market conditions and economic cycles, one would expect the demand for treated wood to parallel these market movements. Secondarily, the repair and remodel demand sector in which decks, stairs, landscape timbers and other treated wood products are used, will influence overall treated wood demand as well. New home construction with treated wood framing is an emerging and potentially important demand application. Respondents are in overall agreement that treated wood is appropriate for framing if used properly and safely.

Overall, respondents have a favorable view of treated wood for a myriad of applications. Although there are safety concerns for certain preservatives, respondents indicate that this material is not only acceptable but is desirable as a material in the homes they build or specify. As new, safer, and more ecologically friendly preservatives come to market, the future will be positive for the treated wood industry in the United States in general and specifically in those states where termites are pervasive.

5 REFERENCES
5. LITERATURA

1. Eisler, P. 2003: Safety concerns cut down treated lumber used by millions, USA TODAY, 12/28/2003
2. Freeman, M.H.; McIntyre, C.R. 2008: A comprehensive review of copper-based wood preservatives with a focus on new micronized or dispersed copper systems. Forest Products Journal, 58 (11): 6-26.
3. Freeman, M.H.; Shupe, T.F.; Vlosky, R.P.; Barnes, H.M. 2003: Past, Present, and Future of the Wood Preservation Industry. Forest Products Journal, 53 (10): 8-15.
4. Hardy, B. 2001: EPA Pressures the Wood-Preservative Industry to Change. Available online at: BobVila.com. Accessed August 11, 2009.
5. Prestemon, D.R. 1994: Wood Use. Selection and Use of Preservative-treated Wood. Iowa State University Extension. PM-1033. Ames, Iowa.
6. Ring, D. 2005: Distribution of Formosan subterranean termites. Http://www.lsuagcenter.com/en/environment/insects/Termites/formosan_termites/ Distribution+of+Formosan+Subterranean+Termites.htm. LSU AgCenter. Baton Rouge, La. Accessed August 11, 2008.
7. Vlosky, R.P. 2009: An overview of the U.S. preservative wood treating industry: 2007. Sponsor report to the Southern Pine Council. Kenner, LA. February 16th. 81 p.
8. Vlosky, R.P. 2006: An overview of the U.S. preservative wood treating industry: 2004. Sponsor report to the Southern Pine Council. Kenner, LA. March 16th. 65 p.
9. Vlosky, R.P.; Shupe, T.F. 2002: Homeowner attitudes and preferences for building materials with an emphasis on treated wood products. Forest Products Journal, 52 (7/8): 90-95.
10. Vlosky, R.P.; Shupe. T.F. 2004: U.S. home builder perceptions about treated wood. Forest Products Journal, 54 (10): 41-48.
11. *** CPSC, 2005: Fact Sheet: Chromated Copper Arsenate (CCA) - Treated Wood Used in Playground Equipment. U.S. Consumer Products Safety Commission, 2005. http://www.cpsc.gov/phth/ccafact.html
12. *** Environmental Protection Agency (EPA), 2002: Available at: http://www.epa.gov/pesticides/citizens/cca_transition.htm
13. *** USDA, 2005: TechLine. US Department of Agriculture. US Forest Products Laboratory. What's in That Pressure-Treated Wood? Madison, Wisconsin.

Corresponding address:

Professor RICHARD VLOSKY, Ph.D. FIWSc

Louisiana Forest Products Development Center
LSU AgCenter
Baton Rouge, Louisiana 70803 USA
e-mail: vlosky@lsu.edu

Nedim Škaljić[1], Ružica Beljo Lučić[2], Ankica Čavlović[2], Murčo Obućina[1]

Effect of Feed Speed and Wood Species on Roughness of Machined Surface

Utjecaj posmične brzine i vrste drva na hrapavost obrađene površine

Preliminary paper · Prethodno priopćenje
Received – prispjelo: 2. 10. 2009.
Accepted – prihvaćeno: 18. 11. 2009.
*UDK: 630*823.11*

ABSTRACT • *In this study, the surface roughness values of planed beech-wood (Fagus L.), oak-wood (Quercus L.) and fir-wood (Abies alba Mill.) specimens were examined. The samples of beech-wood were cut from steamed beech-wood and from thermally modified beech-wood (212°C). The specimens were machined by planing in radial directions with two knives at 6, 12, 18 and 24 m/min feed speed. The cutting depth of 2.0 mm was constant and knife rake angle was 15°. The machining experiments were carried out using a single cutter-block of a Weinig Powermat 400. The cutter-block with a diameter of Ø 125 mm rotated at 6000 revolutions per minute (RPM). Surface roughness was measured from the radial face of each sample according to DIN 4768 (1990) by using Mitutoyo SJ-201 stylus scanner. Comparison between the results of surface roughness of four species showed that surface roughness increases with the increase of feed rate. The surface quality of samples of planed beech-wood, oak-wood and fir-wood were significantly different. The samples of planed surface of oak-wood had the best quality and the samples of fir wood had the highest values of surface roughness. There were no significant differences in the surface quality of thermally modified and steamed beach-wood samples despite the significant difference in mechanical and physical properties of thermally modified and steamed wood.*

Key words: *surface roughness, wood planing, feed speed, wood species*

SAŽETAK • *Rad predstavlja istraživanja kvalitete blanjane površine bukovih, hrastovih i jelovih uzoraka. Bukovi su uzorci izrađeni od parene bukovine i termički modificirane bukovine (212 °C). Istraživanja su provedena na uzorcima blistača, koji su blanjani u radijalnom smjeru. Alat za blanjanje imao je dvije oštrice, a blanjano je pri posmičnim brzinama 6, 12, 18 i 24 m/min. Dubina blanjanja bila je konstantna i iznosila je 2,0 mm, a prsni je kut oštrica alata bio $\gamma = 15^o$. Eksperiment je proveden na četverostranoj blanjalici Weinig Powermat 400. Promjer putanje rezne oštrice bio je 125 mm, a broj okretaja radne osovine 6 000 min^{-1}. Hrapavost površine mjerena je po duljini obrade, u skladu sa normom DIN 4768 (1990) upotrebom elektromehaničkog profilometra Mitutoyo SJ-201. Usporedbom dobivenih rezultata za sve četiri vrste uzoraka može se zaključiti da se s povećanjem posmične brzine povećava hrapavost površine. Kvaliteta blanjane površine za različite je vrste drva različita u jednakim uvjetima obrade. Najmanju hrapavost imali su uzorci hrasta, a najveću uzorci jele. U istraživanjima nije zabilježena značajna razlika između kvalitete površine uzoraka od parene bukovine i termički modificirane bukovine usprkos mnogo lošijim mehaničkim svojstvima termički modificiranog drva u odnosu prema parenom drvu.*

Ključne riječi: *hrapavost površine, blanjanje, posmična brzina, vrsta drva*

[1] Authors are assistent and assistant professor at Faculty of Machining, University of Sarajevo, Sarajevo, Bosnia and Herzegovina. [2]Authors are professor and assistent professor at Faculty of Forestry, University of Zagreb, Zagreb, Croatia.
[1] Autori su asistent i docent na Mašinskom fakultetu Sveučilišta u Sarajevu, Sarajevo, Bosna i Hercegovina. [2]Autorice su profesorica i docentica na Šumarskom fakultetu Sveučilišta u Zagrebu, Zagreb, Hrvatska.

1 INTRODUCTION
1. UVOD

Besides physical, mechanical, and anatomical properties of wood, the surface quality of details and finished products is influenced by numerous factors like: direction of cutting, geometry of the blade and its sharpness, thickness of the cut part, lack of precision of the sharpening tool, technological parameters (speed of cutting, speed of movement, etc.) (Richter *et al*, 1995). The quality of processing includes the precision of processing and quality of the machined surface. These two mutually dependent indicators of the processing quality, which depend on numerous factors, represent the most important conditions in achieving the required product quality. Morphologic properties of the surface that was created through mechanical processing of wood carries a lot of information on the quality of technological procedure with which the surface came to existence. Full understanding and evaluation of the geometric condition of the wood surface and wood material provides mostly technical information in solving the problems like capabilities of gluing, impregnation, strength of joints, control of blade sharpness, and decrease of waste. The relation between surface roughness and wearing of the tools is well known. It is assumed that surface roughness of sawed surfaces of softwoods and hardwoods increases with the increase of wedge radius (Keturakis, 2007). Monitoring of the roughness can provide valuable information on the condition of the blade and vice versa. The strength of the glued joints and other mechanical properties of wood products are also dependent of surface roughness (Malkoçoğlu, 2007). Studies show that smooth surfaces require relatively small amount of paint for surface protection (Marian *et al*, 1958).

In the manufacturing process the occurrence of fault in processing is inevitable. If the quality deviations of the actual properties are within the limit values, then the detail is considered to be properly processed in terms of technological requirements. However, it often happens that the dimensions of the detail are within the limit values, and the details are different in the quality of the machined surface. Sanding is the most common and most influential operation for achieving surface quality during the phase of surface preparation.

This paper presents the research of the influence of the planing regime on the quality of the machined surface and possibilities to leave out the sanding operation by replacing it with planing in the preparation of the surface. Also, the aim of the research was to compare the surface quality of the samples of different wood species and different wood treatment.

2 MATERIAL AND METHODS
2. MATERIJAL I METODE

Testing was conducted on samples of beech-wood (steamed and thermally modified), oak-wood and fir-wood. Dimensions of samples were 70x21x600 mm for steamed beech-wood, oak-wood and fir-wood and 70x21x500 mm for thermally modified beech-wood at 212°C. Samples of wood elements were radial texture with moisture content and density according to Table 1. Before planning, samples were kept in the conditioning room at 20°C temperature and 65 ±5 relative humidity. For each type of timber the average density and humidity of wood were determined. Wood density is determined in accordance with ISO 3131, and wood moisture is determined by gravimetrical method according to the ISO 3130 of 1975.

Table 1 Data of density and moisture content for the studied species of wood
Tablica 1. Podaci za gustoću i sadržaj vode istraživanih vrsta drva

Wood species *Vrsta drva*	**Properties** *Svojstvo*	**Number of samples** *Broj uzoraka*	**Minimum** *Minimum*	**Maximum** *Maksimum*	**Mean** *Srednja vrijednost*	**Std. Dev.** *Standardna devijacija*
Steamed beech-wood *parena bukovina*	density/ *gustoća* g/cm³	30	0,600	0,718	0,664	0,034
	moisture/*sadržaj vode*, %	30	8,85	9,63	9,18	0,070
Thermally modified beech-wood *termički modificirana bukovina*	density/ *gustoća* g/cm³	30	0,607	0,673	0,639	0,023
	moisture/*sadržaj vode*, %	30	4,14	4,76	4,47	0,151
Oak-wood *hrastovina*	density/ *gustoća* g/cm³	30	0,603	0,720	0,655	0,035
	moisture/*sadržaj vode*, %	30	8,67	9,95	9,31	0,401
Fir-wood *jelovina*	density/ *gustoća* g/cm³	30	0,412	0,471	0,434	0,019
	moisture/*sadržaj vode*, %	30	17,37	19,17	18,27	0,541

Figure 1 Cabinet planer (Weinig Powermat 400)
Slika 1. Četverostrana blanjalica (Weinig Powermat 400)

Machining process was conducted with a cabinet planer (Weinig Powermat 400). Only the top spindle of the machine with two knives was used at 125 mm tool diameter. The knives were made of industry standard high-speed steel. The used feed speeds were 6 m/min, 12 m/min, 18 m/min and 24 m/min. The used knife rake angle was 15^o and the depth of cut was 2.0 mm.

For each testing conditions a total of 10 samples were used. Measurements in five different randomly selected surface spots at each sample were averaged. Surface roughness tests were conducted using a Mitutoyo Surftest SJ 201, and carried out according to DIN 4768, 1990. Table 2 lists the characteristics of the tracing process. The values of roughness were determined with a precision of ±0,01 μm.

Table 2 Characteristics of stylus tracing for surface roughness measurements
Tablica 2. Karakteristike mjernog postupka određivanja hrapavosti površine

Tracing length (L_t) / *mjerna duljina*	12,5 mm
Tracing speed / *brzina mjerenja*	0,5 mm/s
Pick-up length (λ_c) / *duljina uzorkovanja podataka*	2,5 mm
Stylus tip radius / *radijus zaobljenja mjerne igle*	5 μm
Stylus tip angle / *kut mjerne igle*	90^o

Figure 2 shows the Mitutoyo Surftest SJ 201 which was used for the current research. Surface roughness was measured on one side of the sample.

Descriptive statistics (mean, minimum, maximum, variance, standard deviation) was made for all analysed variables. The differences between the obtained values of roughness parameter *R*a for different feed speed were tested by the Student's t-test, under assumption that the condition of homogeneity of variance was met (McClive et al., 1988). If the homogeneity of variance were not met, nonparametric comparison of two independent groups would be made by Mann-Whitney u-test. The error of type I (α) of 5 % was considered statistically significant. All statistical analyses have been made by use of the statistics software - STATISTICA 6.0.

3 RESULTS AND DISCUSSION
3. REZULTATI I DISKUSIJA

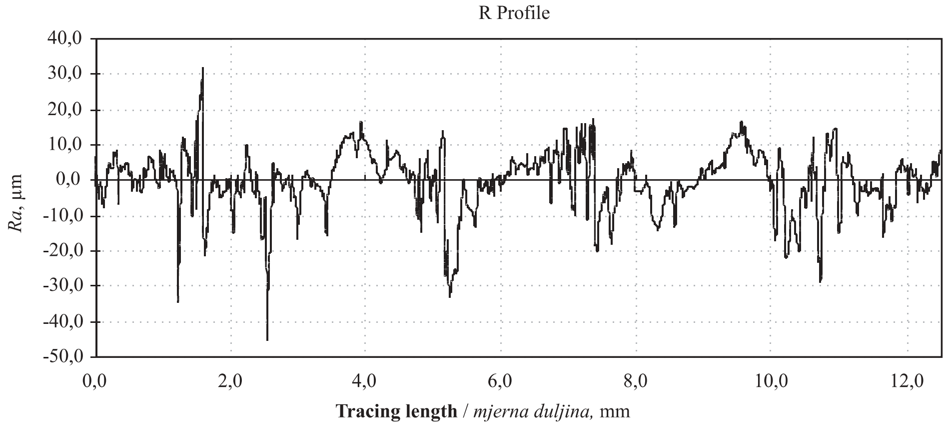
An example of the *R* profiles obtained with our device is presented in Figure 3. The given examples present surface roughness of samples obtained by processing with tool rake angle of 15^o and feed speed of 18 m/min.

Research results are shown in Table 3. The arithmetical mean deviations of the profile (*R*a) present the average roughness value in each group of samples. In order to obtain more accurate results for each sample, measuring of the value *R*a was performed by five measurements and hence we had in total 50 measurements in each group of samples. Mean values of these measurements of arithmetical mean deviation of the profile *Ra*, are presented by the diagram in Figure 4.

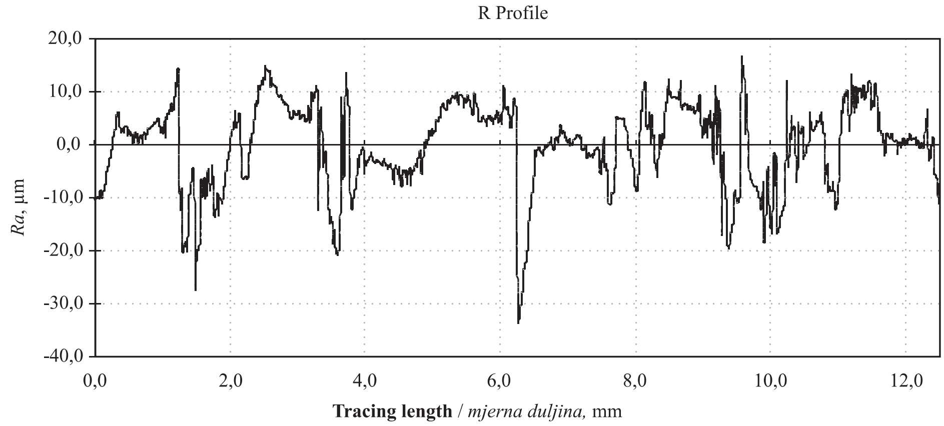
The surface quality of samples of planed beech-wood, oak-wood and fir-wood were significantly different. The best quality of planed surface was achieved by samples of oak-wood, while the samples of fir wood had the highest values of surface roughness. There is no significant difference in surface quality of thermally modified and steamed beach-wood samples despite the significant difference in mechanical properties of the thermally modified and steamed wood.

The results clearly show that the physical and mechanical properties and anatomical structure of wood affect the surface roughness. Resistance to penetration blade cutting edge in the wood depends on the size, shape of cells, as well as thickness and strength of cell

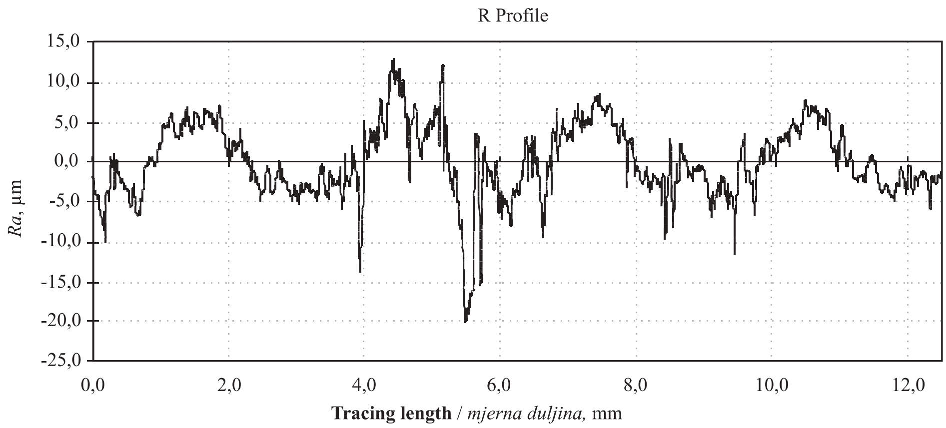
Figure 2 Surface profilometer-Mitutoyo Surftest SJ-201 used in this study
Slika 2. Profilometar Mitutoyo Surftest SJ-201 upotrijebljen u istraživanju



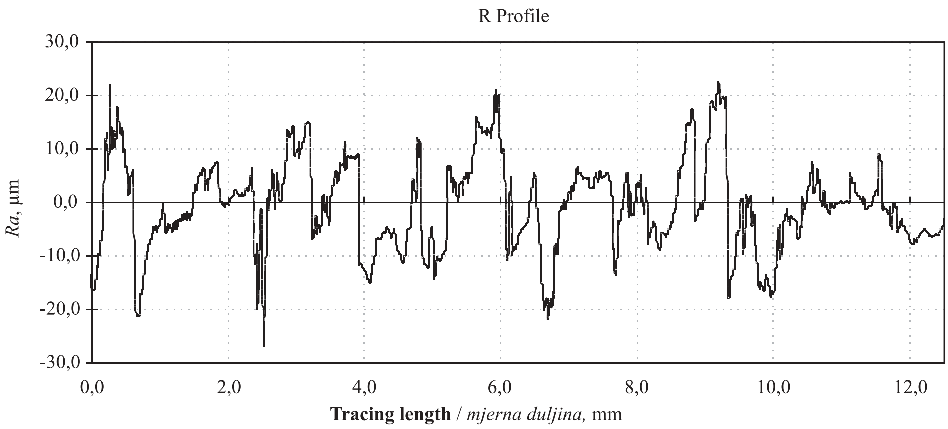
a) Steamed beech-wood / *parena bukovina*



b) Thermally modified beech-wood / *termički modificirana bukovina*



c) Oak-wood / *hrastovina*



d) Fir-wood / *jelovina*

Figure 3 Surface roughness profiles of steamed beech-wood, thermally modified beech-wood, oak-wood and fir-wood
Slika 3. Profil hrapavosti površine parene bukovine, termički modificirane bukovine, hrastovine i jelovine

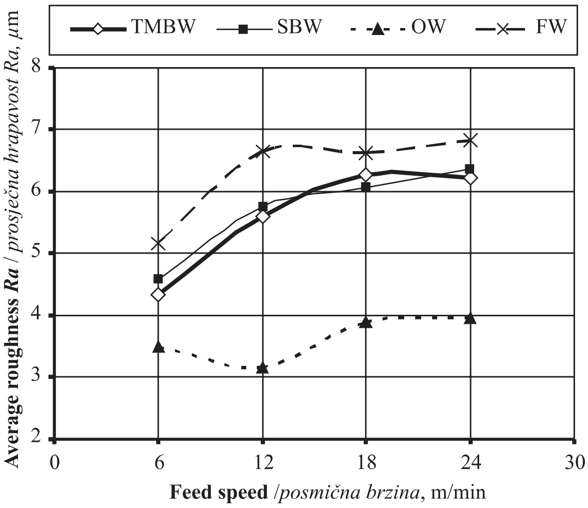


Figure 4 Effect of wood species and feed speed on surface quality (TMBW – Thermally modified beech-wood; SBW - Steamed beech-wood; OW – Oak-wood; FW - Fir-wood)
Slika 4. Utjecaj vrste drva i posmične brzine na kvalitetu obrađene površine (TMBW – termički modificirana bukovina; SBW – parena bukovina; OW – hrastovina; FW – jelovina)

walls. Wood of conifers (fir) has a simpler structure, lower mechanical properties and lower density than deciduous trees (oak and beech). In their researches Malkoçoğlu and Özdemir (2006) and Malkoçoğlu (2007) showed that under the same parameters of processing the surface of conifers (spruce-wood) is of lower quality that the surface of hardwood species (beech wood). It is known from literature that mechanical properties of thermally modified wood are not as good as those of unmodified wood. This research showed that different mechanical properties of steamed and thermally modified beech wood had no effect on the quality of the machined surface of samples under given processing conditions. The samples of thermally modified beech wood, despite mechanical properties of lower quality, had an equally good quality of planed surface as the samples of steamed beech wood.

In their researches Usta *et al* (2007), Örs and Baykan (1999) and Keturakis (2007) showed that the decrease of feed speed results in a better quality of the machined surface. The researches by Malkoçoğlu (2007) also show that the decrease of feed speed and rake angle result in a better quality of the machined surface.

Statistical significance of differences between arithmetic mean values of roughness parameter *Ra*, of individual value pairs for different feed speeds, was tested by use of *t*-test. Table 4 presents the data obtained for *p*. There are significant differences between arithmetic mean values of roughness parameters *Ra* for $p<0.05$.

The axial tool leaves kinematic irregularities on the finished surface in the form of slot cycloid which is characterized by the length and depth of the wave. These parameters directly depend on the feed rate which is proportional to feed speed. As the surface roughness parameter *R*a was measured in direction of fibre length, lower feed rate caused smaller depth of wave, and smal-

Table 3 Statistical processing of measured parameter of surface roughness *Ra*
Tablica 3. Statistička obrada izmjerenih vrijednosti parametra hrapavosti *Ra*

Feed speed *Posmična brzina* m/min	Wood species *Vrsta drva*	**Hrapavost *R*a, µm** / *Surface roughness Ra, µm*					
		Number of samples *Broj uzoraka*	Minimum *Minimum*	Maximum *Maksimum*	Mean *Srednja vrijednost*	Variance *Varijanca*	Std.Dv. *Standardna devijacija*
6	TMBW*	50	2,03	6,72	4,342	1,571	1,253
	SBW	50	2,11	6,71	4,581	1,176	1,085
	OW	50	1,99	6,57	3,490	1,289	1,135
	FW	50	2,11	9,11	5,157	2,743	1,656
12	TMBW	50	2,99	7,34	5,605	1,424	1,193
	SBW	50	2,91	7,95	5,756	1,739	1,319
	OW	50	2,20	4,53	3,154	0,328	0,573
	FW	50	3,58	9,03	6,641	1,585	1,259
18	TMBW	50	3,19	8,83	6,259	1,843	1,358
	SBW	50	4,43	8,05	6,067	1,041	1,020
	OW	50	2,43	5,43	3,896	0,576	0,759
	FW	50	4,24	8,43	6,626	0,953	0,976
24	TMBW	50	4,23	7,97	6,229	1,256	1,121
	SBW	50	3,98	8,45	6,348	1,300	1,140
	OW	50	2,26	5,36	3,960	0,479	0,692
	FW	50	5,05	8,95	6,831	0,894	0,945

*TMBW – Thermally modified beech-wood / *termički modificirana bukovina*; SBW – Steamed beech-wood / *parena bukovina*; OW – oak-wood / *hrastovina*; FW – Fir-wood / *jelovina*

Table 4 Comparison of values of roughness parameter *R*a for different feed speeds
Tablica 4. Usporedba vrijednosti parametra hrapavosti *R*a za različite posmične brzine

Wood species *Vrsta drva*	***p***											
	Feed speed / *posmična brzina*, m/min											
	6	12	6	18	6	24	12	18	12	24	18	24
TMBW*	0		0		0		0		0		0,75	
SBW	0		0		0		0,34		0,05		0,21	
OW	0,43		0		0		0		0		0,77	
FW	0		0		0		0,89		0,66		0,67	

*TMBW – Thermally modified beech-wood / *termički modificirana bukovina*; SBW – Steamed beech-wood / *parena bukovina*; OW – oak-wood / *hrastovina*; FW – Fir-wood / *jelovina*

ler average value of the arithmetical mean deviation of the profile *R*a was estimated at lower feed speed.

Meanwhile, it can be concluded from the presented results that neither of four groups of samples (steamed beech-wood, thermally modified beech-wood, oak-wood and fir-wood) shows any significant difference at a 5% level between mean values of roughness parameter *Ra* of samples planed at feed speeds of 18m/min and 24 m/min. In machining fir-wood samples, with the increase of feed speed above 12 m/min, the obtained data of mean values of roughness parameter *Ra* show no significant difference at a 5% level.

4 CONCLUSIONS
4. ZAKLJUČAK

The research of the surface quality of samples of beech-wood (steamed and thermally modified), oak-wood and fir-wood was conducted on samples planed at different feed speed.

In the group of sixteen samples, oak-wood samples showed the lowest value of mean deviation profiles while fir-wood samples showed the highest value of surface roughness parameter. The average value of the arithmetical mean deviation of the profile *R*a of the thermally modified beech-wood was very close to the same values of steamed beech-wood samples. It can be concluded that in all four types of samples the increase of feed rate results in the increase of the average value of the arithmetical mean deviation of the profile *R*a. This particularly applies to feed speed up to 18 m/min. No significant change of roughness parameter *Ra* was recorded at feed speed ranging between 18 and 24 m/min.

In general, better results of the machining performance have been obtained with the decreasing feed speed. In the literature, it has been reported that increasing feed speed caused strong machining defects (Koch, 1964); (Malkoçoğlu, 2007).

Further research of the surface quality of planed samples should be carried out on samples planed at higher revolutions (higher cutting speed) with more knives on the planing tool.

5 REFERENCES
5. LITERATURA

1. Koch, P. 1964: Wood Machining Processes. Ronald Press Company, New York 530p.
2. Keturakis, G.; Juodeikiene, I. 2007: Investigation of Milled Wood Surface Roughness. Materials Science (Medžiagotyra), 13 (1).
3. Malkoçoğlu, A. 2007: Machining properties and surface roughness of various wood species planed in different conditions. Building and Environment, 42 (7): 2562-2567.
4. Malkoçoğlu, A.; Özdemir, T. 2006: The machining properties of some hardwoods and softwoods naturally grown in Eastern Black Sea Region of Turkey. Journal of Materials Processing Technology, 173 (3): 315-320.
5. Marian, J.E.; Stumbo, D.A.; Maxey, C.W. 1958: Surface texture of wood as related to glue-joint strenght. Forest Prod. J. 12: 345-351.
6. McClave, J., Dietrich, F.H., 1988. Statistics. Dellen Publisher Company, San Francisco.
7. Örs Y., Baykan I., 1999: The effect of planing and sanding on surface roughness of massive wood. Turkish Journal of Agriculture & Forestry, 23: 577-582.
8. Richter, K.; Feist, W.C.; Knabe, M.T. 1995: The effect of surface roughness on the performance of finishes. Part 1 Roughness characterization and strain performance. Forest Prod. J. 45(7/8):91-97.
9. Usta, I.; Demirci, S.; Kilic, Y. 2007: Comparison of surface roughness of Locust acacia (*Robinia pseudoacacia L.*) and European oak (*Quercus petraea* (Mattu.) Lieble.) in terms of the preparative process by planing. Building and Environment, 42: 2988-2992.
10. *** DIN 4768 (1990). Determination of values of surface roughness parameters, R_a, R_z, R_{max}, using electrical contact (Stylus) instruments. Concepts and measuring conditions.

Corresponding address:

MSc NEDIM ŠKALJIĆ

Faculty of Machining, University of Sarajevo
Vilsonovo šetalište 9
Sarajevo, Bosnia and Herzegovina
e-mail: skaljic@mef.unsa.ba

Mario Koprolčec[1], Krešimir Greger[2], Andreja Pirc[2], Maja Moro[2]

Osiguranje imovine kao rizik u poslovanju drvnog sektora

Insurance of Assets as a Risk in Wood Sector

Prethodno priopćenje · Preliminary paper
Prispjelo – received: 17. 8. 2009.
Prihvaćeno – accepted: 18. 11. 2009.
*UDK: 630*79*

SAŽETAK • *U četiri tvrtke koje se bave preradom drva analizirane su postojeće police osiguranja. Istraživanjem je utvrđeno da promatrane tvrtke ne uviđaju potrebu za kvalitetnim osiguranjem. Analizom polica osiguranja u razdoblju od 2002. do 2006. godine uočen je trend kretanja prema širem i obuhvatnijem osiguranju imovine i imovinskih interesa, ali je taj trend prespor. Istodobno je opasnost od velikoga štetnog događaja koji nije obuhvaćen policama osiguranja znatna. Stabilnost tvrtki temelji se na sigurnosti u radu, a s kvalitetnim osiguranjem imovine i imovinskih interesa tvrtke bi sigurnije poslovale. Osiguranje imovine specifičan je problem i zahtijeva širu obradu kako bi potreba za osiguranjem bila kvalitetno prezentirana. Ovaj rad naglašava potrebu osiguranja imovine, a posebno će u vremenu koje dolazi osiguranje imovine i imovinskih interesa biti sve potrebnije i sve važnije za stabilno poslovanje tvrtki.*

Ključne riječi: *prerada drva, premija osiguranja, osiguranje imovine, osigurani rizik, polica osiguranja*

ABSTRACT • *The analysis of the existing situation in four companies involved in wood processing has shown that all of these were covered by insurance policies. The study revealed that the observed companies do not see the need for high-quality insurance. A trend was noted, albeit too slow, towards a wider and more comprehensive insurance coverage of assets and assets interests. At the same time there is a high and significant risk of a possible major accident that is not covered by insurance policies. The stability of companies is based on operations security, and better quality of assets and assets interest insurance would result in higher security of operations. Assets insurance is a specific issue and a wider perspective is required in order to properly present the need for insurance.*
The present paper will show that assets insurance is indispensable. The results of the study indicate that in the forthcoming period the insurance of assets and assets interests will become more essential and more significant.

Key words: *wood processing, insurance premium, assets insurance, insured risk, insurance policy*

1. UVOD
1 INTRODUCTION

Osiguranje imovine dobiva sve veću ulogu u drvnom sektoru. Pojam rizika u poslovanju odavno je poznat (Šafar, 1999). Globalizacija svjetskog tržišta i ubrzan razvoj tehnologija popraćen je i djelovanjem osiguravateljskih društava te se danas moguće osigurati od različitih opasnosti.

Danas su tvrtke svjesne opasnosti od mogućih šteta na imovini te rizik sve više prepuštaju osiguravateljima.

Tvrtke za preradu drva u Republici Hrvatskoj prihvaćaju promjene novog vremena i žele se kvalitet-

[1] Autor je zaposlenik tvrtke Triglav osiguranje d.d., Republika Hrvatska. [2] Autori su asistent, znanstvena novakinja i asistentica Šumarskog fakulteta Sveučilišta u Zagrebu, Republika Hrvatska.
[1] The author is an employee of the insurance company "Triglav osiguranje", Croatia. [2] The authors are assistant, junior researcher and assistant at the Faculty of Forestry, University of Zagreb, Croatia.

no osigurati kako bi imale što veću sigurnost za svoju opstojnost.

Praćenjem podataka uočen je trend rasta i proširenja osiguravateljskih pokrića, odnosno sve veća potreba da se radi sigurnosti poslovanja rizik smanji do najmanje moguće razine.

Osiguravateljska usluga definirana je kao trgovanje rizicima (Andrijašević i Petranović, 1999). Od uspostave osiguranja kao djelatnosti, osiguravatelji su se povezivali (Andrijanić i Klasić, 2002) jer bez povezivanja osiguranje ne bi moglo funckonirati, ne bi se mogao pokriti rizik. Zakon velikih brojeva sa svojim obilježjima uvjetovao je povezivanje osiguravateljskih društava. Reosiguranje i suosiguranje stari su koliko i osiguravateljska djelatnost. To su pojmovi koji pokazuju da su počeci osiguranja i globalizacija bili istodobni procesi. Neizvjesnost koja je bila bitna odrednica poslovnih pothvata u prošlosti lakše se podnosila uz mogućnost osiguranja pothvata.

Praćenjem činjenica lako je uočljivo da se svjetska globalizacija odražava i na Republiku Hrvatsku (Sabadi, 1992). Želimo li opstati na svjetskom tržištu, moramo biti izvozno orijetirani i prihvatiti mnogo novih načina rada. Uz obvezno praćenje svih novih metoda, kao i upravljanje ljudskim potencijalima, potrebno se brinuti o svemu što dolazi, ali i o onome što već posjedujemo (Marušić, 2001). Orijentacija na izvoz jedini je mogući način tržišnog opstanka koji se za sada zasniva na izvozu poluproizvoda i sirovine. Činjenice pokazuju da se tvrtke što prije trebaju prestrukturirati, prihvatiti standarde i uključiti se u europsku proizvodnju.

Struktura drvnoga gospodarstva Republike Hrvatske u posljednjih se nekoliko godina posve promijenila u korist malih tvrtki. Samoj toj činjenici u prilog idu i podaci koji u obzir uzimaju jedan od parametara za određivanje veličine tvrtke, a to je broj zaposlenih djelatnika. U Republici Hrvatskoj 2005. godine bilo je 585 tvrtki do 20 zaposlenih, 31 tvrtka od 21 – 50 zaposlenih, 60 tvrtki od 50 – 100 zaposlenih, a 63 tvrtke s više od 100 zaposlenih (www.biznet.hr).

S obzirom na njihovu ulogu, u drvnom gospodarstvu Republike Hrvatske nužno je razlikovati tri skupine malih i srednjih tvrtki.

U prvu se skupinu ubrajaju tradicionalne male i srednje tvrtke koje proizvode robu i usluge namijenjene lokalnom tržištu. Drugu skupinu čine male i srednje tvrtke – kooperanti velikih tvrtki koje izravno konkuriraju na regionalnome, nacionalnome ili međunarodnom tržištu, ali su suočene s konkurencijom ostalih domaćih proizvođača. Treću skupinu čine neovisne male i srednje tvrtke koje samostalno nastupaju na stranom tržištu i trebale bi predstavljati skupinu koja će biti vodeća snaga u izvozu.

Uz pomoć osiguravateljskog stručnjaka poduzetnik bi trebao odabrati najbolju kombinaciju postupanja s određenim rizikom (Frančišković i Zelenika, 1996). Rizik je stanje u kojemu postoji mogućnost negativnog odstupanja od poželjnog ishoda koji očekujemo ili kojemu se nadamo (Vaughan i Vaughan, 1995).

Postoje četiri odabira:
- potpuno otkloniti rizik,
- apsorbirati rizik samoosiguranjem,
- prevenirati pojavu gubitka, tj. smanjiti vjerojatnost nekog događaja,
- prenijeti rizik na druge putem osiguranja.

Današnje poslovanje tvrtki postavlja visoke zahtjeve u svakom smislu, pa i u uspostavi sigurnosti poslovanja (Bijelić, 2003). Teži se kontinuiranome i nadgledanom procesu proizvodnje u kojemu više nema “crnih rupa“ i u kojemu se sve planira te, u konačnici, kontrolira. Jedan od tih segmenata (kvaliteta sirovina, kvaliteta strojeva i alata, kvaliteta proizvodnih procesa, sigurnost poslovanja – osiguranje imovine i imovinskih interesa i dr.) svakako je sagledavanje rizika imovine od mogućih nenadanih i neželjenih gubitaka, a samim time osiguranje imovine postaje nezaobilazan dio planske strategije malih i srednjih tvrtki drvnog sektora. Tvrtke posjeduju sve veću imovinu i osiguravatelji pri njihovu osiguranju moraju prihvaćeno reosigurati u osiguranje (Petranović, 1984).

Cilj istraživanja bio je analiza postojećeg stanja u tvrtkama, i to praćenjem u sadašnjem vremenu, kao i u proteklom vremenskom razdoblju od pet godina, ali i usporedbom s *Modelom 11* prikazati kako se tvrtke osiguravaju, a kako bi se trebale osiguravati ako žele sigurnije poslovati.

2. MATERIJALI I METODE
2 MATERIALS AND METHODS

Na osnovi definiranih ciljeva istraživanja postavljena je metoda rada koja se sastojala od sljedećih faza:
1. postavljanje radne hipoteze - *Modela 11,*
2. izbor i opis istraživačkih poligona,
3. snimanje pokrivenosti određenih rizika

2.1. Postavljanje radne hipoteze i definiranje minimalno potrebnih osiguranja
2.1 Work hipothesys and definitions of minimum required insurance

Obavljena prethodna istraživanja i iskustva u osiguranju temelj su postavljanja hipoteze da bi male i srednje tvrtke drvnog sektora trebale biti osigurane po *Modelu 11*, odnosno da bi trebale imati 11 vrsta osiguranja, i to: 1.osiguranje od požara, 2. osiguranje od kvara stroja, 3. osiguranje od provalne krađe, 4. osiguranje stakla, 5. osiguranje od potresa, 6. osiguranje šomaža, 7. osiguranje od opće odgovornosti, 8. osiguranje računala, 9. osiguranje robe u zakupu, 10. osiguranje proizvodnog procesa, 11. osiguranje od proizvođačke odgovornosti.

Za kvalitetno pokrivanje rizika potrebno je imati najmanje navedenih 11 vrsta osiguranja. Svaka od tih vrsta pokriva određene rizike i uz njih je pokrivenost rizika gotovo potpuna, odnosno ta osiguranja daju visok stupanj sigurnosti. Navedeno definira hipotezu o 11 potrebnih vrsta osiguranja.

Ako neka od tvrtki drvnog sektora nema određenu opremu kupljenu na leasing, trebala bi biti osigurana po *Modelu 10'*, no može se predvidjeti da će

Tablica 1. Opći podaci o istraživačkim poligonima
Table 1 General data of research polygons

Poligon / *Polygon*	A	B	C	D
ukupni prihod, kn / *Total income*, kn	9 300 000	5 900 000	4 100 000	5 400 000
broj zaposlenih / *Number of employees*	24	18	11	15
Dobit, kn / *Profit, kn*	71 000	39 000	94 000	146 000

većina tvrtki drvnog sektora imati dio opreme kupljene na leasing pa samim time govorimo o *Modelu 11* .

Promatrane su tvrtke karakteristične i zato što nisu osigurane kod istog osiguravatelja, a time predloženi model ima teoretsko i praktično značenje te potvrđuje da tvrtke po predloženom *Modelu 11* mogu raditi s bilo kojim osiguravateljskim društvima, ali prema predloženome modelu.

2.2. Izbor i opis istraživačkih poligona
2.2 Choice of research polygons

Pri odabiru istraživačkih poligona odabrane su četiri tvrtke, od kojih su dvije obrtničke, s manje zaposlenih, dok su dvije male tvrtke s 20 zaposlenih. Jedan istraživački poligon orijentiran je potpuno izvozno, dok su tri istraživačka poligona orijentirana isključivo na domaće tržište.

Istraživački poligoni po mnogočemu su različiti (po ukupnom prihodu, broju zaposlenih, dobiti i dr.) (tablica 1), pa i po proizvodnom programu.

Poligoni su snimani tijekom određenoga vremenskog razdoblja i dobiveni su podaci prikazani do razine koju dopušta poslovna politika određenog poligona. Naime, direktori poligona važnom smatraju tajnost podataka te su usuglašeni okviri u kojima će se odraditi snimanje poligona i situacije u njima.

2.3. Snimanje vrsta osiguranja istraživačkih poligona
2.3 Insurance types in polygons

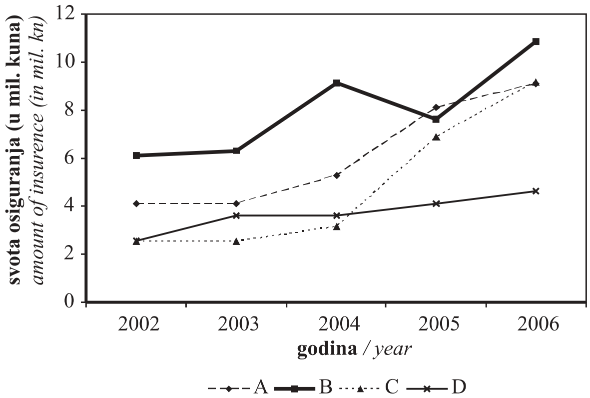
U razdoblju od pet godina prikupljeni su podaci o tome kako promatrani istraživački poligoni funkcioniraju u osiguravateljskom smislu i uspoređeni su s *Modelom 11*, odnosno prikupljeni su svi podaci o tome što je sve osigurano, kako je osigurano i u kojem rasponu osiguravateljskog pokrića (tabl. 2. do 6).

3. REZULTATI I DISKUSIJA
3 RESULTS AND DISCUSSION

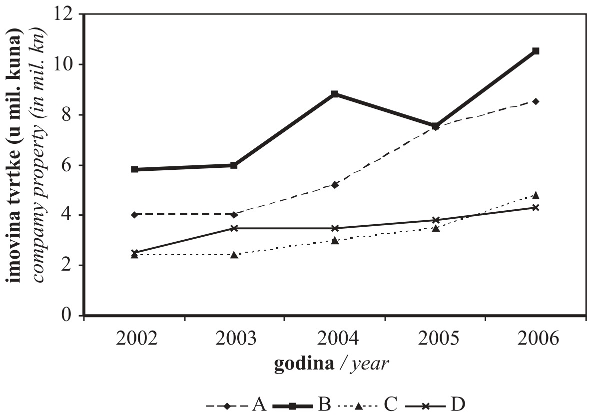
U grafičkim prikazima od 1. do 3. objedinjeni su podaci za sve poligone i napravljen je prikaz trenda i navedenih odnosa.

U pet promatranih godina vidljiv je rast imovine tvrtki, a samim time i svote osiguranja, kao i rast premije osiguranja. Premije osiguranja za sva četri promatrana poligona rastu, ali sporije od ukupne vrijednosti promatranih poligona, što upućuje na zaključak da je osiguranje tvrtki sve jeftinije.

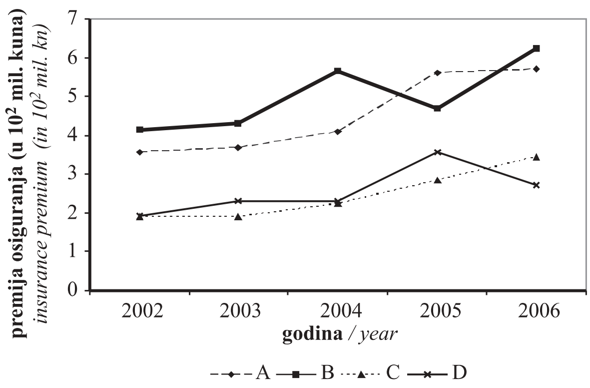
Ako promatramo odnos premije osiguranja i štete, vidljivo je da je stvarna premija dvostruko manja od štete, što je vidljivo iz tablica 2. do 5. S obzirom na



Slika 1. Kretanje svote osiguranja u istraživanim poligonima
Figure 1 Trend of insurance amount in research polygons



Slika 2. Kretanje imovine tvrtke u istraživanim poligonima
Figure 2 Trend of company assets in research polygons



Slika 3. Kretanje premije osiguranja u istraživanim poligonima
Figure 3 Trend of insurance premium in research polygons

sve navedeno, osiguranje imovine i imovinskih interesa nije preskupo jer bi u slučaju velike štete (požara, oluje, smrtnog događaja s odgovornošću tvrtke itd.) osiguranje i odgovarajuća osiguravajuća polica bili najveća i najsigurnija zaštita koja ipak ima svoju cijenu.

Tablica 2. Pokrivenost određenih rizika poligona A (u kn)
Table 2 Certain risk coverage – polygon A (in HRK)

Poligon A / *Polygon A*															
Godina *Year*	**2002.**			**2003.**			**2004.**			**2005.**			**2006.**		
Vrsta osiguranja *Insurance type*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*
pož	3 000 000	15 400	1 000	3 000 000	16 400	8 000	4 000 000	18 600	33 000	5 000 000	19 000	33 000	6 000 000	19 400	5 000
str	1 000 000	19 000	11 000	1 000 000	19 000	35 000	1 200 000	21 000	25 000	2 500 000	25 000	25 000	2 500 000	25 000	8 000
vlm	100 000	1 300	0	100 000	1 300	0	100 000	1 300	0	100 000	1 300	0	100 000	1 300	0
skl	0	0	0	0	0	0	0	0	0	0	0	0	10 000	500	0
potr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
šom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
odg	0	0	0	0	0	0	0	0	0	195 000	5 800	22 000	195 000	5 800	0
rac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
zak	0	0	0	0	0	0	0	0	0	300 000	5 000	8 000	300 000	5 000	8 000
sur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
oiz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Legenda *legend*	pož – požar , str – kvar stroja , vlm – provala , skl – lom stakla , potr – potres , šom – šomaž , odg – odgovornost , rac – osiguranje računala, zak – osiguranje robe u zakupu, sur – osiguranje od šteta u proizvodnom procesu, oiz – osiguranje od proizvođačke odgovornosti *pož – fire, str – mashine break, vml – burglary , skl – glass break , potr – earthquake , šom – interruption insurance, odg – responsibility , rac – computer insurance , zak – leasing insurance, sur – insurance against damage made in production process , oiz – manufacturer responsibility*														

Tablica 3. Pokrivenosti određenih rizika poligona B (u kn)
Table 3 Certain risk coverage – polygon B (in kn)

Poligon B / *Polygon B*															
Godina *Year*	**2002.**			**2003.**			**2004.**			**2005.**			**2006.**		
Vrsta osiguranja *Insurance type*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** losses	**Svota osiguranja** *amount insured*	**Premija** premium	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*
pož	5 000 000	23 400	10 000	5 000 000	23 000	17 000	7 300 000	31 000	7 000	5 000 000	19 000	33 000	8 000 000	33 400	12 000
str	800 000	14 000	11 000	1 000 000	16 000	17 000	1 500 000	20 000	4 000	2 500 000	25 000	25 000	2 500 000	23 000	6 000
vlm	300 000	4 000	0	300 000	4 000	0	300 000	4 000	6 000	100 000	1 300	0	300 000	4 000	0
skl	0	0	0	0	0	0	15 000	1 000	7 000	0	0	0	15 000	1 000	0
potr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
šom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
odg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rac	0	0	0	0	0	0	10 000	500	4 000	30 000	1500	6 000	35 000	2 000	400
zak	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
oiz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Legenda *legend*	pož – požar , str – kvar stroja , vlm – provala , skl – lom stakla , potr – potres , šom – šomaž , odg – odgovornost , rac – osiguranje računala, zak – osiguranje robe u zakupu, sur – osiguranje od šteta u proizvodnom procesu, oiz – osiguranje od proizvođačke odgovornosti *pož – fire, str – mashine break, vml – burglary , skl – glass break , potr – earthquake , šom – interruption insurance, odg – responsibility , rac – computer insurance , zak – leasing insurance, sur – insurance against damage made in production process , oiz – manufacturer responsibility*														

Tablica 4. Pokrivenosti određenih rizika poligona C (u kn)
Table 4 Certain risk coverage – polygon C (in kn)

Poligon C / *Polygon C*															
Godina *Year*	**2002.**			**2003.**			**2004.**			**2005.**			**2006.**		
Vrsta osiguranja *Insurance type*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** losses	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*
pož	2 000 000	9 000	0	2 000 000	9 000	5 000	2 500 000	11 000	8 000	3 000 000	13 000	20 000	4 000 000	17 000	3 000
str	400 000	6 100	3 000	400 000	6 100	11 000	500 000	7 000	8 000	500 000	7 000	4 000	800 000	8 000	2 000
vlm	150 000	1 900	0	150 000	1 900	0	150 000	1 900	0	150 000	1 900	0	150 000	1 900	0
skl	4 000	1 900	0	4 000	1 900	0	4 000	1 900	1 900	4 000	1 900	2 000	4 000	1 900	2 000
potr	0	0	0	0	0	0	0	0	0	3 000 000	2 700	0	4 000 000	3 600	0
šom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
odg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rac	0	0	0	0	0	0	10 000	500	4 000	15 000	800	3 000	15 000	800	4 000
zak	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
oiz	0	0	0	0	0	0	0	0	0	195 000	1 200	0	195 000	1 200	0
Legenda *legend*	pož – požar , str – kvar stroja , vlm – provala , skl – lom stakla , potr – potres , šom – šomaž , odg – odgovornost , rac – osiguranje računala, zak – osiguranje robe u zakupu, sur – osiguranje od šteta u proizvodnom procesu, oiz – osiguranje od proizvođačke odgovornosti *pož – fire, str – mashine break, vml – burglary , skl – glass break , potr – earthquake , šom – interruption insurance, odg – responsibility , rac – computer insurance , zak – leasing insurance, sur – insurance against damage made in production process , oiz – manufacturer responsibility*														

Tablica 5. Pokrivenosti određenih rizika poligona D (u kn)
Table 5 Certain risk coverage – polygon D (in kn)

Poligon D / *Polygon D*															
Godina *Year*	**2002.**			**2003.**			**2004.**			**2005.**			**2006.**		
Vrsta osiguranja *Insurance type*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*	**Svota osiguranja** *amount insured*	**Premija** *premium*	**Šteta** *losses*
pož	2 000 000	10 000	0	3 000 000	14 000	5 000	3 000 000	14 000	8 000	3 000 000	14 000	4 000	3 500 000	16 000	5 000
str	500 000	8 000	6 000	500 000	8 000	4 000	500 000	8 000	5 000	800 000	8 000	10 000	800 000	8 000	6 000
vlm	100 000	1 200	0	100 000	1 200	2 000	100 000	1 200	0	100 000	12 000	0	100 000	1 200	0
skl	0	0	0	0	0	0	0	0	0	10 000	500	0	10 000	500	2 000
potr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
šom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
odg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rac	0	0	0	0	0	0	0	0	0	0	0	0	10 000	200	0
zak	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
oiz	0	0	0	0	0	0	0	0	0	195 000	1 200	0	195 000	1 200	0
Legenda *legend*	pož – požar , str – kvar stroja , vlm – provala , skl – lom stakla , potr – potres , šom – šomaž , odg – odgovornost , rac – osiguranje računala, zak – osiguranje robe u zakupu, sur – osiguranje od šteta u proizvodnom procesu, oiz – osiguranje od proizvođačke odgovornosti *pož – fire, str – mashine break, vml – burglary , skl – glass break , potr – earthquake , šom – interruption insurance, odg – responsibility , rac – computer insurance , zak – leasing insurance, sur – insurance against damage made in production process , oiz – manufacturer responsibility*														

Tablica 6. Zbirni pregled vrsta osiguranja poligona
Table 6 Summary of insurance types

Vrsta osiguranja *Insurance type*	**Poligon A** *Polygon A*	**Poligon B** *Polygon B*	**Poligon C** *Polygon C*	**Poligon D** *Polygon D*
pož	X	X	X	X
str	X	X	X	X
vlm	X	X	X	X
skl	X	X	X	X
potr	X	X	X	X
šom				
odg	X			
rac		X	X	X
zak	X			
sur				
oiz			X	X

Legenda : pož – požar , str – kvar stroja , vlm – provala , skl – lom stakla , potr – potres, šom – šomaž, odg – odgovornost, rac – osiguranje računala, zak – osiguranje robe u zakupu, sur – osiguranje od šteta u proizvodnom procesu, oiz – osiguranje od proizvođačke odgovornosti

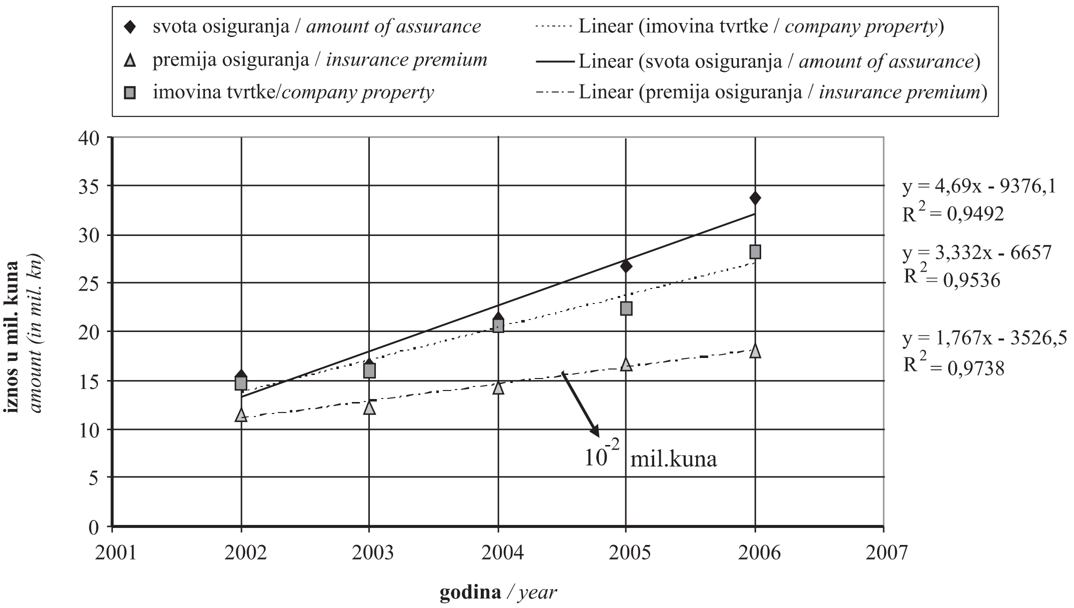
Legend: pož – fire, str – mashine break, vml – burglary, skl – glass break, potr – earthquake , šom – interruption insurance, odg – responsibility, rac – computer insurance, zak – leasing insurance, sur – insurance against damage made in production process, oiz – manufacturer responsibility

Prema tablici 6, prve četiri vrste osiguranja posjeduju svi promatrani poligoni, dok je za petu vrstu vidljivo da promatrani poligon B nema takvu osiguravajuću policu. Šomažno osiguranje ne posjeduje nijedan promatrani poligon, što nije prihvatljivo jer bi mogući požar u tvrtkama uzrokovao veliku materijalnu štetu i onemogućio pokrivanje troškova zastoja proizvodnje zbog požara. Osiguranje od opće odgovornosti posjeduje samo promatrani poligon A .

Poligoni se koriste osiguravateljskom zaštitom, ali u nedovoljnom opsegu jer znatno odstupaju od *Modela 11.*

Snimanjem postojećeg stanja uočeno je da poligoni nemaju isti model osiguranja i ne pridržavaju se *Modela 11*, odnosno nemaju osiguranjem pokrivene sve rizike koje bi trebali imati prema postavljenoj hipotezi.

Razlog zbog kojega se poligoni ne pridržavaju *Modela 11* jest pretpostavka da im je osiguranje trošak koji treba smanjivati i teško im je predvidjeti i matematički izračunati vrijednost osiguravajuće zaštite, što je pogrešno. Svakako bi trebali bi promijeniti način razmišljanja jer bi samo jedna velika šteta ugrozila poslovanje a plaćanjem premije osiguranja tvrtke kupuju sigurnost.



Slika 4. Trendovi svote osiguranja, imovine tvrtke i premije osiguranja za promatrano razdoblje
Figure 4 Trends of insurance amount, company asset and insurance premium in research period

4. ZAKLJUČAK
4 CONCLUSION

Grafički prikaz na slici 4. pokazuje da se, promatrano kroz godine, svota osiguranja, imovina tvrtke i premija osiguranja kreću prema modelu linearnog trenda (identičan je modelu linearne regresije).

U sva tri promatrana primjera zabilježen je uzlazni trend, s vrlo visokim koeficijentom determinacije (R^2) što ukazuje da se *linearnim trend-modelom* objašnjavaju periodične promjene zabilježene u razdoblju od 2002. do 2006. godine, i to 94,92% promjena za svote osiguranja, 95,36% promjena za imovinu tvrtke i 97,38% promjena za premije osiguranja.

Na temelju praćenja podataka premije osiguranja i šteta za male i srednje tvrtke na području prerade drva i proizvodnje namještaja kao prihvatljiv i ekonomski opravdan predlaže se *Model 11*. Iz tablica 2. do 5. proizlazi da upravo taj model nudi dostatnu osiguravateljsku zaštitu za najmanju količinu novčanih jedinica. Posebno se naglašava da taj model ne pokriva sve štetne događaje, ali osigurava dovoljno širok raspon za objektivno prihvatljivu sigurnost tvrtki.

Na primjeru istraživanih poligona vidljivo je da oni nisu imali nijednu veću štetu, pa je samim time osiguranje trošak, ali ako oduzmemo sve male štete koje su imali, onda je to malen trošak. Svaka velika šteta još bi dodatno upozorila na potrebu osiguravateljske zaštite.

Poligoni bi trebali prihvatiti *Model 11* te premiju prihvatiti kao vrlo razuman trošak kojim kupuju sigurnost za tvrtku i sve njezine zaposlenike.

Model 11 prihvatljiv je i zato što je osiguravateljsko pokriće dovoljno obuhvatno, te su na taj način pokriveni samo određeni rizici, dok dio rizika snosi tvrtka, a premija osiguranja postaje planirani trošak. Moguće štete koje bi nastale uz takvo osiguranje ne bi dodatno opteretile poslovanje tvrtki drvnog sektora. S obzirom na to da je cilj ovog istraživačkog rada bilo uočavanje i analiza postojećeg stanja malih tvrtki, potrebno je naglasiti da one same mogu odlučiti kako će se postaviti prema riziku svog poslovanja.

Svakako valja naglasiti da je planirani trošak zasigurno najbolji trošak i svakom je vlasniku tvrtke prihvatljiviji negoli neplanirani trošak odnosno gubitak što bi ga mogao prouzročiti neki štetni događaj koji je moguće pokriti osiguranjem.

5. LITERATURA
5 REFERENCES

1. Andrijanić, I.; Klasić, S., 2002: Tehnika osiguranja i reosiguranja. Mikrorad, Zagreb.
2. Andrijašević, S.; Petranović, V., 1999: Ekonomika osiguranja. Alfa, Zagreb.
3. Bijelić, M., 2003: Osnove osiguranja i reosiguranja. Tactus, Zagreb.
4. Frančišković, I .; Zelenika, R., 1996: Teorija i praksa osiguranja. Ekonomski fakultet u Rijeci, Croatia osiguranje d.d., Zagreb.
5. Petranović, V., 1984: Osiguranje i reosiguranje. Informator, Zagreb.
6. Sabadi, R., 1992: Ekonomika šumarstva, Školska knjiga, Zagreb.
7. Šafar, Ž., 1997: Osiguranje imovine. Preluk, Rijeka.
8. Vaughan, E.; Vaughan, T., 2000: Osnove osiguranja upravljanje rizicima. Mate, Zagreb.
9. Marušić, S., 2001: Upravljanje i razvoj ljudskih potencijala. Ekonomski institut Zagreb, Adeco Zagreb, Zagreb.
10. Www.biznet.hr

Corresponding address:

MSc. MARIO KOPROLČEC

Triglav osiguranje, d.d.
1. svibnja 21, 48362 Kloštar Podravski
e-mail: sinaco1@gmail.com

DRVNA INDUSTRIJA

ZNANSTVENO-STRUČNI ČASOPIS ZA PITANJA DRVNE TEHNOLOGIJE

SCIENTIFIC AND PROFESSIONAL JOURNAL OF WOOD TECHNOLOGY

Izdavač: Sveučilište u Zagrebu, Šumarski fakultet

Glavni i odgovorni urednik: prof. dr. sc. Ružica Beljo Lučić

Adresa: Svetošimunska 25, HR-10000 ZAGREB

tel. +385 1 235 2430

Časopis je dostupan na Internetu http://drvnaindustrija.sumfak.hr

Drvna industrija je jedini hrvatski znanstveno-stručni časopis za pitanja drvne tehnologije. Već 57 godina objavljuje izvorne znanstvene, stručne i pregledne radove, prethodna priopćenja, izlaganja sa savjetovanja, stručne obavijesti, bibliografske radove, preglede te ostale priloge s područja iskorištavanja šuma, biologije, kemije, fizike i tehnologije drva, pulpe i papira te drvnih proizvoda, uključivši i proizvodnu, upravljačku i tržišnu problematiku u drvnoj industriji.

Časopis izlazi kvartalno.

Godišnja pretplata u Hrvatskoj na časopis "Drvna industrija" iznosi 300 kn, a 100 kn za đake, studente i obrazovne institucije.

Uplata na žiro račun 2360000-1101340148 s naznakom "za Drvnu industriju".

PRATITE HRVATSKU ZNANOST

PRIHVATITE STRUČNE INFORMACIJE

PRIMAJTE REDOVITE STRUČNE OBAVIJESTI

PRENESITE SVOJU PORUKU

Drvna industrija objavljuje i stručne priloge i informacije kojima proizvođači strojeva, opreme, uređaja i repromaterijala mogu redovito obavještavati tehnološki i rukovodeći kadar u hrvatskim drvnoindustrijskim poduzećima o ponudi svojih proizvoda. Sve informacije na adresi redakcije.

Silvana Prekrat, Nikola Španić[1]

Znanstvene metode određivanja drvnih konstrukcija kutnih sastava

Scientific Methods for Determination of Wooden Corner Joint Designs

Pregledni rad · Review paper
Prispjelo – received: 15. 7. 2009.
Prihvaćeno – accepted: 18. 11. 2009.
*UDK: 630*824.1; 674.028*

SAŽETAK • *U današnjim uvjetima potrošačkog mentaliteta posebno je izražena potreba za konkurentnošću i profitom u proizvodnji namještaja. U fazama projektiranja od konstruktora se očekuje brz, pouzdan i financijski isplativ izbor konstrukcijskih rješenja, usklađenih s ponuđenim dizajnerskim rješenjem. Način utvrđivanja kvalitativnih svojstava konstrukcije prema propisanim normama za ispitivanje namještaja sve češće zamjenjuju simulacijski modeli ispitivanja konstrukcije.*
U radu se obrađuju metode ispitivanja određenih konstrukcija namještaja na primjeru kutnih konstrukcijskih oblika sastavljanja, u kojima se primjenjuje ovaj način sastavljanja. Pri tome su prikazana i usustavljena istraživanja s provedenim analizama činitelja koji utječu na kvalitetu namještaja.
Budući da nisu pronađeni idealni računalni modeli koji bi mogli zamjeniti stvarna ispitivanja konstrukcijskih sastava, može se očekivati da će se u budućnosti više pozornosti usmjeriti na pronalaženje modela za primjenu računalno modeliranih konstrukcijskih rješenja primjenjivih u fazi projektiranja i konstruiranja.

Ključne riječi: *namještaj, drvni konstrukcijski sastav, čvrstoća, krutost, računalni modeli*

ABSTRACT • *At the present time and under current market conditions, where the interest is focused on fast profit, furniture constructor has to offer a fast, reliable and not expensive choice of construction solution according to designer's demands. The way of deformation of construction durability according to regulations and standards for furniture testing is nowadays often replaced with simulation models for construction testing.*
This paper presents the analysis of methods for testing construction assemblies. Examples are given for corner joints and furniture having this type of joint.
The results of systematic research are also presented with the analysis of parameters affecting the quality of furniture. Since no precise computatonal models have been determined that could replace the actual testing of construction assemblies, in future a more intensive research can be expected in finding models for applying computer-based modelling applicable in developing and designing phase of production.

Key words: *furniture, wooden construction joint, rigidity, computational models*

1. UVOD
1 INTRODUCTION

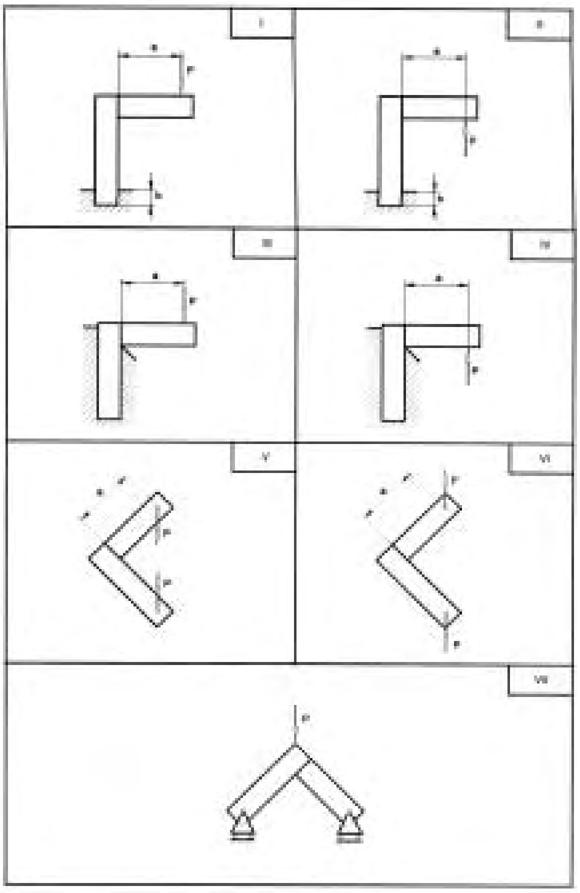
Na osnovi dizajnerskoga idejno-oblikovnog i funkcionalnog rješenja namještaja konstruktor odabire prikladna konstrukcijska rješenja prilagođena obličju i namjeni proizvoda. Zbog brzih promjena oblika kao posljedica modnih trendova, te čestog povećanja broja novih materijala, intuitivan način odabira konstrukcijskog rješenja ustupa mjesto znanstvenim metodama

[1] Autori su docentica i asistent na Šumarskom fakultetu Sveučilišta u Zagrebu, Zagreb, Hrvatska.
[1] Authors are assistant professor and assistent at Faculty of Forestry, University of Zagreb, Zagreb, Croatia.

(Tkalec i Prekrat, 2000). Relativno skupa ispitivanja kvalitete gotovih proizvoda radi određivanja najpovoljnijega konstrukcijskog rješenja danas se zamjenjuju parcijalnim ispitivanjima dijelova i sklopova namještaja. S vremenom je empirijski zaključeno da se vjerodostojni rezultati istraživanja mogu zamjeniti ispitivanjima najopterećenijih sklopova namještaja. U tom je smislu kriterij odabira načina ispitivanja kvalitete namještaja prilagođen načinu upotrebe i podijeljen je u dvije skupine s obzirom na opterećenje, koje može biti statičko ili dinamičko.

Poput građevinske, automobilske, avionske i brodograđevne struke, s razvojem računalne tehnologije omogućena su istraživanja konstrukcija namještaja proračunima. Ovim je načinom istraživanja svojstava sklopova omogućeno određivanje kvalitete u najranijoj fazi, što bitno utječe na smanjenje troškova uvjetovanih popravcima, tj. izmjenom konstrukcijskih rješenja nakon utvrđene nezadovoljavajuće razine tehničke kvalitete ispitanoga gotovog proizvoda. Radovi utemeljeni na računalnim proračunima sadržavaju teoretske modele izražene matematičkim formulama.

Kako istraživanja postaju sve brojnija, raste i broj relevantnih podataka kao osnova za buduća istraživanja. Samim time pojavljuje se potreba za sustavnim prikazom postojećih rezultata.



Slika 1. Konstrukcijsi oblici (L) kutnih spojeva ispitivani na statička opterećenja
Figure 1 Construction type (L) corner joints testet on static load

2. METODE ISTRAŽIVANJA TEHNIČKE KVALITETE KONSTRUKCIJSKIH SASTAVA NAMJEŠTAJA
2 METHODS FOR RESEARCH OF TEHNICAL QUALITY OF FURNITURE ASSEMBLIES

Da bi se utvrdila razina tehničke kvalitete, gotovi se proizvodi izlažu ispitivanjima prema opisanim normama za ispitivanje namještaja. Radovi koji opisuju istraživanja provedena na gotovim proizvodima starijeg su datuma i uglavnom se odnose na proizvode manjih dimenzija kao što su stolice i manji ormari (Eckelman i sur. 1969; Dziuba i Kwiatkowski, 1976; Kamenicky, 1982; Dziegielewsky i sur. 1983; Eckelman, 1989; Tkalec i Prekrat, 1997). Njihov je doprinos potvrda mogućnosti izvođenja parcijalnog ispitivanja sastava, što omogućuje jeftiniji i brži postupak dobivanja rezultata.

Osim istraživanja objavljenih na proizvodima, ispitivanja kojima se istražuje tehnička kvaliteta odnose se na konstrukcijske sastave koji se dijele u dvije skupine: nerastavljive, odnosno spojeve, i rastavljive, odnosno vezove. Najčešće su i dosadašnji radovi podijeljeni u te skupine, no sve se češće pojavljuju radovi koji obuhvaćaju istraživanja konstrukcija nastalih kombinacijom spojeva i vezova.

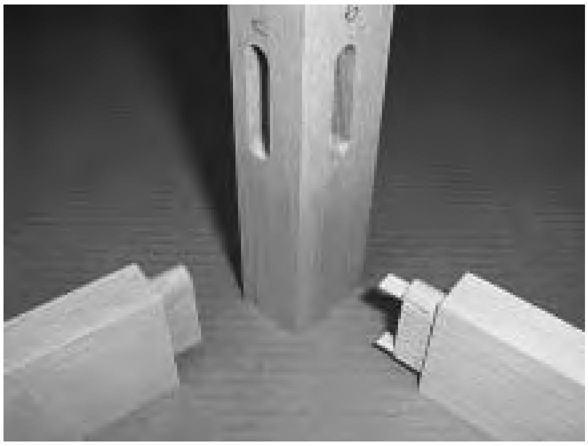
Osim navedene podjele, radovi obrađuju različite kriterije kvalitete koja je u konstrukcijskom smislu definirana izdržljivošću konstrukcije. Neka od istraživanja obuhvaćaju više od jednog čimbenika, pa ih je katkad teško raščlaniti prema jednome od navedenih kriterija. Način na koji se odabire metoda ispitivanja ovisi o načinu upotrebe namještaja, tj. o opterećenju u stvarnim uvjetima korištenja, a metoda je podijeljena na statička i dinamička ispitivanja. U skladu s tim primjeri kutnog sastavljanja opisani u ovom radu podijeljeni su na kutno bočne ili okvirne i kutno plošne ili korpusne.

Primjer pregleda načina ispitivanja kutnih spojeva na statička opterećenja (sl. 1) u svom radu iznosi Warmbier (1997), koji proučava razlike između dobivenih rezultata momenata sile loma zbog različitih položaja i načina primjene opterećenja istovrsnih uzoraka.

2.1. Istraživanja utjecaja konstrukcijskih čimbenika
2.1 Research of construction parameters

Budući da je konstrukcijsko rješenje određeno dizajnerskim oblikovnim rješenjem, česta su istraživanja provođena na dimenzijski istovrsnim uzorcima sastavljenima na različite načine, pri čemu su upotrijebljeni različiti spojni ili vezni elementi, od kojih su najčešći zaobljeni čep u podužnoj rupi, utor i pero, moždanici, čepovi i raskoli, umeci, vijci i svornjaci. U ovim su istraživanjima promatrani utjecaji vrste, geometrije, tj. oblika spojnih elemenata te njihove dimenzije (Richards, 1962; Korzienowski, 1968, 1974, 1984; Eckelman, 1970; Dzigielewski i Zenkteler, 1975; Vince 1975; Tkalec i sur., 1997). Gotovo u svim radovima istaknuta je važnost površine lijepljenja kao najvažnijeg kriterija postignute čvrstoće. U radu Prekrat i sur. (2004) uz spomenutu je tvrdnju dokazano da je inoviranim sastavom promijenjene geometrije (sl. 2, 3 i 4) i manjom površinom lijepljenja moguće postići jednake ili čak bolje rezultate.

Slika 2. Kutni konstrukcijski oblik sastavljanja noge stolice s bočnom i stražnjom okvirnicom sastavljene zaobljenim čepom sa skošenim sučeljem u podužno glodanim rupama
Figure 2 Round-head mortise diagonally shortened in the tennons with lenthwise hole



Slika 3. Kutni konstrukcijski oblik sastavljanja noge stolice s bočnom i stražnjom okvirnicom pri čemu je bočna okvirnica spojena zaobljenim čepom s umecima, a stražnja zaobljenim čepom i utorom
Figure 3 Round-head mortise with bolts

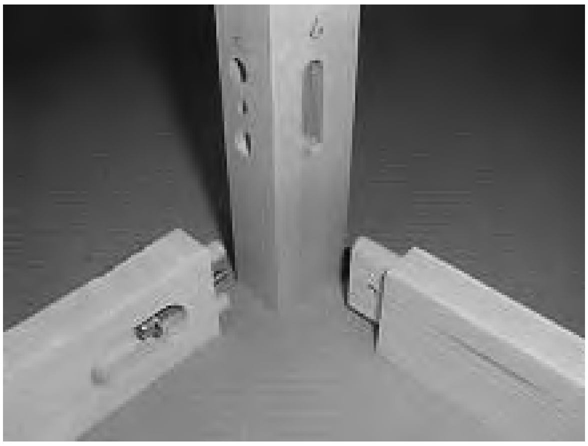
Opisanom je konstrukcijom postignuta racionalizacija materijala smanjenjem poprečnog presjeka noge sa 45 x 45 mm na 26 x 26 mm. Također je dokazana tvrdnja da je moguće postići veću čvrstoću uz gotovo identičnu površinu lijepljenja (tabl. 1).

2.2. Utjecaj tehnoloških čimbenika
2.2 Influence of technological parameters

Već je navedeno da je za čvrstu lijepljenu konstrukciju potrebno osigurati što veću površinu lijepljenja, elemente lijepiti u paralelnom položaju vlakanaca te izbjegavati lijepljenje pod kutom. Budući da je te uvjete pri kutnom spajanju nemoguće poštovati, autori su istražili druge čimbenike koji mogu pridonijeti čvrstoći konstrukcije. Biniek i Smardzewski (1987) ustanovili su da je s povećanjem vlage s 11,6 na 18,1% čvrstoća smanjuje za 15%, a pri povećanju na 35% za čak 75%. Utjecaj tehnike nanošenja ljepila istražio je Dzigielewski (1991), koji je dokazao varijaciju čvrstoće od 18% ovisno o načinu nanošenja ljepila. Utjecaj ljepila u konstrukciji istraživali su Tankut i Tankut (2004), pri čemu su ispitivali vlačnu i tlačnu čvrstoću kutno plošnih uzoraka od MDF-a i furnirske ploče spojenih eliptičnim umetkom. Rezultati su potvrdili ispitivanja Zhanga i Eckelmana (1993), koji su dokazali slabije rezultate tlačno opterećenih kutnih uzoraka za oba materijala.

2.3. Distribucija naprezanja u konstrukcijskim sastavima namještaja
2.3 Distribution in furniture construction assemblies

Statistički neodređene prostorne strukture konstrukcija namještaja reducirane su na tip položenih ok-



Slika 4. Kutni konstrukcijski oblik sastavljanja noge stolice s bočnom i stražnjom okvirnicom od kojih je bočna okvirnica spojena zaobljenim čepom, a stražnja okruglim čepovima, vijkom i T (unit) maticom
Figure 4 Round-head mortise in combination with dowel, through-bolt and T unit

virnih konstrukcija (Eckelman, 1970; Ganowicz i Nowak, 1976; Dziêgielewski i Smardzewski, 1992). Usprkos tome, problem određivanja pouzdane vrijednosti čvrstoće konstrukcijskih sastava i oblika raspodjele naprezanja u pojedinačnim spojevima nije riješen. Djelomično rješenje problema dala bi primjena numeričkih metoda modeliranja 3D konstrukcija, torzijski, smično i savojno opterećenog korpusnog namještaja (Wilczyñski, 1988; Pellicane, 1994; Dziêgielewski i Smardzewski, 1994; Smardzewski, 1994; Smardzew-

Tablica 1. Deskriptivna statistika momenta savijanja (Nm) za sve skupine uzoraka
Table 1 Descriptive statistics for bending moment (Nm) of all group specimens

Grupa *Group*	**Broj uzoraka** *Number of specimens*	**Aritmetička sredina** *Arithmetical mean*	**Minimum** *Minimum*	**Medijan** *Median*	**Maksimum** *Maximum*	**Standardna devijacija** *Standard deviation*	**Površina lijepljenja** *Glued surface*
A	29	1543,6	1361,2	1543,8	1543,8	90,83	16,45
B	27	1451,2	1186,9	1419,3	1859,2	174,7358	11,88
C	35	2240,1	1784,5	1784,5	2265,9	236,2236	17,56

ski i Dziêgielewski, 1996; Smardzewski, 1991, 1996; Nakai i Takemura, 1995; Curtu i suradnici, 1996, 1997; Smardzewski i Papuga, 2004.). No time nije u potpunosti riješeno pitanje karakteristika definiranja ponašanja konstrukcije kutnih spojeva prostornih konstrukcija namještaja u uvjetima realnog opterećenja. Za potpuno definiranje problema potrebno je u uzajaman odnos dovesti stanje opterećenja namještaja sa stanjima opterećenja u spojevima.

Smardzewski i Papuga (2004) odredili su distribuciju naprezanja namještaja povezanoga kutnim spojevima izvedenima čepom i rupom te kutnim spojevima izvedenima moždanicima. Rezultatima analize provedene na uzorcima kutnih spojeva stolica, pri čemu su analizirani samo najopterećeniji dijelovi konstrukcije, omogućeno je optimalno konstruiranje prostornih struktura namještaja podvrgnutoga stvarnim opterećenjima. Oni ujedno upućuju na mjesta koncentriranih naprezanja i time ta mjesta čine bitnima za buduće analize rezultata istraživanja.

Iz rezultata istraživanja raspodjele naprezanja u slojevima lijepila spojeva s moždanicima jasno je vidljivo da su najveća naprezanja nastala u spojevima horizontalne okvirnice uz sjedalo i stražnje noge. Naprezanja osobito karakterizira ekstremno povećanje njihove vrijednosti u središtu slojeva. U spojeva s moždanicima ispitivani su samo gornji ili donji moždanik spoja, ovisno o tome gdje su, prema von Misesovoj hipotezi, zabilježene veće vrijednosti naprezanja.

2.4. Utjecaj dimenzija elemenata spoja na čvrstoću i krutost spojeva izvedenih zaobljenim čepom i podužnom rupom
2.4 Influence of joint element dimensions on strength and rigidity of round mortise and tenon joints

Budući da je spoj zaobljenim čepom i podužnom rupom najzastupljeniji u kutnim konstrukcijama, i najveći broj radova opisuje istraživanja koja se odnose na uvjete što ih trebaju zadovoljiti konstrukcije sastavljene na taj način.

Hill i Eckelman (1973) proveli su opsežno istraživanje za određivanje čvrstoće i krutosti spojeva čepom i rupom. Procijenili su utjecaj varijabilnosti pojedinih dimenzija tj. dužine i širine čepa na konačne iznose krutosti spojeva. Utjecaj širine i dužine čepa istraživao je i Kamenicky (1975), no ta su istraživanja usmjerena na samo ka određivanje elastičnosti, odnosno krutosti spoja.

Iz navedenoga, se jasno zaključuje da su utjecaji dužine i širine čepa istraživani zasebno. Ispitivanje utjecaja svih dimenzija čepa na čvrstoću i krutost spojeva čepom i rupom proveli su Wilczyñski i Warmbier (2003). Ispitivanje je obavljeno na uzorcima spoja izrađenoga od bukovine (*Fagus silvatica* L.), a zaključeno je sljedeće: što su širina i debljina čepa veći, to je veći i utjecaj duljine čepa na čvrstoću spoja. Krutost testiranih spojeva i njihova čvrstoća rastu s povećanjem dimenzija spoja a utjecaj debljine čepa na koeficijent krutosti spoja, otprilike je linearan.

2.5. Analiza modela krutost čvrstoća i distribucije naprezanja spojeva učvršćenih čepom i rupom te opterećenih na torziju
2.5 Rigidity Strength analysis and strain distribution in mortise and tenon joints during torsion loading

Istraživanjima obilježja primjenjenih spojeva, s ciljem optimizacije korpusnog namještaja i smanjenja iskorištenosti materijala, bavili su se Eckelman i Suddarth (1969), Smardzewski (1991), Dziêgielewski i Smardzewski (1992), Gogolin, Wilczyñski i Warmbier (1996), Wilczyñski i Warmbier (1996), Tkalec i Prekrat (1997), Prekrat i sur. (2004), Smardzewski i sur. (2008). Međutim, istraživanja navedenih autora usmjerena su na utvrđivanje elastičnih konstanti i konstanti čvrstoće spojeva čepom i rupom, te spojeva moždanicima opterećenjima na savijanje. Daljnjim analiziranjem unutarnjih sila i naprezanja u elementima konstrukcije namještaja za sjedenje zaključeno je da su najopterećeniji sklopovi ipak mnogo kompleksnije opterećeni (Nakai i Takemura, 1995, 1996), Smardzewski i Prekrat (2004).

Najbitnija činjenica u istraživanjima navedenih autora bila je neusklađenost kuta rotacije konstrukcijskih spojeva s geometrijskom središnjom osi presjeka čepa, što je rezultiralo stvaranjem dodatnih momenata savijanja. Taj je nepovoljni faktor u ispitivanjima izbjegnut primjenom specijalne naprave opremljene hvataljkama s ležajevima, čime su osigurani uvjeti opterećenja najsličniji čistom savijanju (Gawroñski, 2006). Predmet ovog istraživanja bio je učvršćeni spoj izvedeni zaobljenim čepom i rupom. Dimenzije ispitnog spoja odabrane su na osnovi prijašnjih analiza tipičnih konstrukcijskih rješenja spajanja namještaja kutno bočnim načinom. Kao vrsta drva odabrana je bukovina (*Fagus silvatica L.)*, a kao vezivo polivinil-acetatno lijepilo.

Istraživanje je provedeno na osnovi dvaju numeričkih modela navedenog tipa spoja: grednog i prostornog modela. Znatno jednostavniji, gredni model omogućuje dobivanje rezultata proračuna u znatno kraćem vremenu. Zbog toga je prikladan za optimizaciju cijelih kostura namještaja, pri čemu se zbog znatnog broja ponavljanja i primjene algoritama zahtijeva brza verifikacija čvrstoće. Kombiniranjem željenih konstanti materijala s vrijednostima sile i pomaka registriranih tijekom opterećivanja uzoraka realnih spojeva, dolazi se do vrijednosti ekvivalentnih obilježja elastičnosti grednog modela i matematičkih korelacija za opis dobivenog modela.

Drugi primijenjeni model bio je prostorni model na bazi konačnih elemenata kubnog tipa, a primjer je primijenjenih spojeva i adhezijske veze. Stoga taj model ima potencijalnu primjenu pri određivanju optimalnih dimenzija spoja i analize naprezanja spoja. Osnovni nedostatak tog modela velik je broj konačnih elemenata koji povećavaju složenost proračuna. Pri primjeni tog modela ključna je usporedba rezultata dobivenih njegovim korištenjem s rezultatima dobivenim laboratorijskim istraživanjima, u jednakom uvjetima opterećenja.

2.6. Određivanje krutosti namještaja primjenom polukrutih sastava
2.6 Rigidity determination by semirigid assemblies

Vijčani spojevi korpusnog namještaja pripadaju skupini polukrutih vezova, u kojih krutost svih dijelova konstrukcije uvjetuje krutost cijelog sustava. Pri proračunu takvi se sastavi nikako ne smiju smatrati idealno krutima jer bi to bilo odveć pojednostavnjeno, pogotovo za vezne elemente sa zglobovima. Sama činjenica da se ti vezovi smatraju polukrutima omogućuje ispravna matematička objašnjenja i izradu numeričkih modela konstrukcijske krutosti namještaja povezanog upotrebom vijaka.

Krutost namještaja ustanovljena je istraživanjima na osnovi matematičkog modela polukrutoga kutnog veza confirmat vijkom te određivanjem naprezanja u spojenim elementima (Smardzewski i Ožarska, 2005). Ispitivanje je provedeno na kutnim bočnim sastavima od troslojne ploče iverice, međusobno povezane confirmat vijkom. Na osnovi geometrijskih obilježja vijka i konstanti materijala troslojne ploče iverice određen je utjecaj tlačenja vijka uzimanjem u obzir samo opterećenja nastalih djelovanjem ruba glave vijka ili opterećenja nastalih djelovanjem konusnog dijela glave vijka. Na osnovi tako dobivenih podataka konstruiran je numerički model polukrutih kutnih vezova confirmat vijkom.

Von Misesova raspodjela reduciranih naprezanja tog tipa povezivanja pokazuje da se najveća naprezanja pojavljuju na mjestu spoja vertikalnoga i horizontalnog elementa pritisnutih glavom vijka. U praktičnim uvjetima konstruiranja namještaja sastavi su mnogo kompleksnije opterećeni. Zbog deformacije veznog elementa i iskrivljavanja pločastih elemenata dolazi do promjene geometrije konstrukcijskog sastava, čija krutost tada ovisi isključivo o geometriji elemenata nakon deformacije i o međusobnom odnosu svojstava materijala. Pri provedbi numeričkih proračuna autori su zaključili da je nužno procijeniti vrijednost naprezanja uzrokovanog pločama pri deformaciji. Najnepovoljnije je opterećenje ono pri kojemu se naprezanje koncentrira na rubovima ploče iverice.

2.7. Određivanje izvlačne i lomne čvrstoće sastava OSB i furnirskih ploča
2.7 Determination of tension and fracture strength of OSB and plywood assembly

Načini povezivanja vijkom i uložnom maticom primjenjuju se za povezivanje konstrukcijskih elemenata namještaja i to kao osnovni vezni elementi ili kao dodatni vezovi. Takav način povezivanja nije nov i godinama se upotrebljava za povezivanje, primjerice, stranica kreveta s uzglavljem. Naravno, konstrukcija takvih tipova vezova razvijala se godinama. Uz primjenu u konstrukcijama rastavljivog namještaja vezovi vijkom i uložnom maticom primjenjuju se i u konstrukcijama stolica jer zbog velike čvrstoće i pouzdanosti služe za učvršćenje kritičnog mjesta sastava stražnje noge i okvirnice (Eckelman, 1989), (Prekrat i sur. 2004.)

Povezivanje OSB i furnirskih ploča takvim načinom uvjetovano je spoznajama o njihovoj izdržljivosti i čvrstoći u navedenim tipovima materijala. To se posebice odnosi na izvlačnu čvrstoću uložne matice iz ruba sastava. Kod dvostrukih vezova pimjenom ovih veznika osobito je važan utjecaj razmaka između dvaju vijaka s maticama na maksimalne vrijednosti momenta loma i lomne čvrstoće.

Izvlačna čvrstoća matica na rubovima furnirskih i OSB ploča, te lomna čvrstoća dvostrukog veza tog tipa ispitivana je radi određivanja prikladnosti takvog načina povezivanja pločastih elemenata s ciljem izrade konstrukcijskih okvira za ojastučeni namještaj (Erdil i sur. 2003). Ispitivanje je provedeno na uzorcima OSB ploča različitih gustoća i na uzorcima furnirnirskih ploča izrađenih od tvrdih, odnosno mekih listača. Ispitivanje je provedeno na grupama od četiri uzorka napravljena od svakoga navedenog materijala. Može se zaključiti da lomna čvrstoća raste proporcionalno s povećanjem udaljenosti između dvaju veznih elemenata u dvostrukim vezovima tog tipa. Iz navedenih je vrijednosti lako razlučiti i to da su dvostruki vezovi tog tipa prikladni za izradu konstrukcijskih okvira ojastučenog namještaja, kojih se traže čvrsti i pouzdani sastavi.

3. DISKUSIJA
3 DISCUSSION

Sumirajući podatke istraživanja drugih autora obrađenih u ovom radu, može se postaviti nekoliko zajedničkih osnovnih hipoteza.

Čvrstoća i krutost skeletnoga i korpusnog namještaja prije svega ovisi, o konstruktivnim, materijalnim, tehnološkim i uporabnim činiteljima. Svaki od navedenih činitelja ima određeni utjecaj na trajnost i sigurnost dotične vrste namještaja. Samim time definira se cijena proizvodnje i prodajna cijena namještaja. Zbog toga su razloga sva istraživanja provedena parcijalno, pri čemu su ispitivani samo najopterećeniji dijelovi sklopova namještaja, podvrgnuti djelovanju opterećenja identičnih onima u eksploatacijskim uvjetima. Ispitivani su najčešći načini kutnog sastavljanja drvnih konstrukcija, podijeljeni u dvije skupine: konstrukcijski spojevi i konstrukcijski vezovi. Laboratorijskim ispitivanjima uzoraka sastava željelo se doći do podataka o raspodjeli naprezanja u sastavima. Analizom tako dobivenih podataka izrađeni su matematički i/ili numerički modeli kojima se najbolje opisuje utjecaj pojedinih tipova naprezanja, ili je taj utjecaj prikazan grafički.

U ispitivanju konstrukcijskih spojeva odabrani, karakteristični način sastavljanja bio je onaj s čepom i rupom. Rezultati istraživanja osnova su za optimalan dizajn jer pružaju nova znanja o naprezanjima unutar sastava, kako u elementima spoja, tako i u slojevima ljepila. U spojeva čepom i rupom najviše su vrijednosti tangencijalnog naprezanja uslijed djelovanja momenta loma zabilježene na rubnim dijelovima veze drva i ljepila. To pokazuje da je posljedica slabljenja i kidanja takve veze izvlačenje čepa iz rupe. Vrijednosti tangencijalnog naprezanja spojeva s moždanicima karakterizira ekstremno povećanje njihove vrijednosti u središtu slojeva ljepila. Usporedbom vrijednosti tangencijalnih naprezanja spojeva s moždanicima i vrijednosti naprezanja spojeva s čepom i rupom primjećuje se 30% manja vrijednost naprezanja u linijama lijepljenih spojeva s čepom i rupom. Prikupljeni podaci numeričkih proračuna analiziranih spojeva upozoravaju na mjesta s najvećim iznosima naprezanja i time daju osnovu za buduće analize rezultata istraživanja.

Utjecaj dimenzija spoja na njegova mehanička svojstva velika je. Iznosi lomne čvrstoće i krutosti spojeva čepom i rupom rastu s porastom dimenzija spoja. Glede čvrstoće spoja, najveći je utjecaj duljine čepa, dok su utjecaji promjene širine i debljine čepa manji. Najbolji pokazatelj navedenoga jest podatak da povećanje duljine čepa s 10 na 42 mm rezultira povećanjem čvrstoće spoja koje prosječno iznosi 227,6%. No valja napomenuti da s povećanjem širine i debljine čepa raste i utjecaj duljine pera na čvrstoću spoja (Wilczyñski i Warmbier, 2003). Krutost ispitivanih spojeva, kao i njihova čvrstoća, raste s povećanjem dimenzija spoja. Koeficijent krutosti spoja sve više raste s povećanjem širine pera. Povećanje koeficijenta u ovisnosti o povećanju širine pera to je tim veće što su veće duljina i debljina pera. Prosječno povećanje koeficijenta krutosti uzrokovano povećanjem širine pera s 18 na 50 mm iznosi 336,5% (Wilczyñski i Warmbier, 2003). Na osnovi navedenoga zaključuje se da je utjecaj širine pera na krutost spoja mnogo veći od utjecaja dužine i debljine pera.

Za ispitivanje konstrukcijskih vezova odabrana su dva reprezentativna načina povezivanja, točnije, polukruti kutni vezovi confirmat vijkom i kutni vezovi vijkom i uložnom maticom. Maksimalni moment pritezanja u vezovima confirmat vijkom ne uzrokuje naprezanja koja mogu oštetiti ploču duž navoja vijka, no pritom se do pojavljuju lomna naprezanja u ploči pritisnutoj glavom confirmat vijka. Matematičkim modelom svinutih kutnih vijčanih vezova confirmat vijcima opisan je izgled deformacije konstrukcijskog sastava, kao i utjecaj momenta loma na fleksibilnost veznika i povezanih materijala (Smardzewski i Ožarska, 2005).

Rezultati ispitivanja sastava od furnirskih i/ili OSB ploča povezanih vijkom i uložnom maticom pokazuju izuzetno visoke iznose izvlačne i lomne čvrstoće, upozoravajući time na mogućnost primjene tog načina povezivanja pri izradi konstrukcijskih okvira ojastučenog namještaja. U osnovi, pozicioniranje uložne matice relativno blizu ruba sastavnog elementa, za vrijednosti od 25,4 mm od ruba i više, za OSB ploče nije kritično (Erdil i sur. 2003). Na furnirskim pločama s porastom udaljenosti rastu i iznosi izvlačne čvrstoće. Delaminaciju krajeva povezanih elemenata od furnirskih ploča moguće je izbjeći primjenom uložnih matica dugačkih barem toliko kolika je debljina elementa u koji se usađuju (Erdil i sur. 2003).

Potrebno je naglasiti da je katkad rezultate teško uspoređivati zbog nedostatnih podataka autora, npr. točnog opisa svojstava materijala od kojih su izrađeni uzorci. To se posebno odnosi na različite značajke iste vrste drva s različitih staništa. Također su često nedostatni podaci o tehničkim čimbenicima elemenata sastava.

4. ZAKLJUČAK
4 CONCLUSION

U današnjim uvjetima potrošačkog mentaliteta, u kojima je potreba za konkurentnošću i profitom osobito naglašena, od konstruktora se očekuje brz i pouzdan izbor konstrukcijskog rješenja usklađenog s estetskim kriterijima definiranim dizajnerskim rješenjem. Način utvrđivanja izdržljivosti konstrukcije prema propisanim normama za ispitivanje namještaja sve češće zamjenjuju simulacijski modeli ispitivanja konstrukcije. Računalne tehnike nude kraći put otkrivanja nedostataka odabranoga konstrukcijskog rješenja. Budući da nisu pronađeni idealni računalni modeli koji bi mogli zamijeniti praktična ispitivanja konstrukcijskih sastava, može se očekivati da će se u budućnosti više pozornosti pridati traženju modela za primjenu računalno modeliranih konstrukcijskih rješenja upotrbljenih u definiranju kvalitete proizvoda u fazi projektiranja i konstruiranja.

5. LITERATURA
5 REFERENCES

1. Biniek, P.; Smardzewski, J. 1987: Effect of simultaneous changes in several factors on the strength of fork-tenoned joints, Przemysl - Drzewny, 38 (11): 6-8.
2. Cutru, I.; Szava, J.; Crisan, R., 1996: Utilizarea mef şi interferometriei holografice la studiul stârilor de tensiuni în îmbinările realizate din materiale ortotrope, Suceava, 201-210.
3. Cutru, I.; Crisan, R.; Barbu, C.; Curtu, L., 1997: Aspects of glue line stress – strain state of wooden joints, Pokroky vo vyrobe a pouziti lepidie v drevopriemysle, Vinne, 121-128.
4. Dziegielewski, S.; Zenkteler, M., 1975: Badania nad polaczeniami szkieletowych konstukcji mebla z drewna, Folia Forestalia Polonica, seria B, 12, 133-156.
5. Dziegielewski, S.; Giemza, I.; Grbac, I., 1983: Istraživanje statičke i dinamičke čvrstoće stolica kao parametra njihove kvalitete, Drvna industrija, 34 (1-2): 5-9.
6. Dziegielewski, S.; 1991: Sposoby nanosenia klejuna powierzchine zlaczy a jakosc polaczenia. Przemysl Drzewny, 7: 10-13.
7. Dziegielewski, S.; Smardzewski, J., 1992: Sztywnosc i wytrzymałosc połaczen katowych wykonanych z płyt MDF [Stiffness and strength of corner joint made of MDF], Przemysl Drzewny, 5: 6-8.
8. Dziegielewski, S.; Smardzewski, J., 1994; Rozkład naprężeń w spoinie połączenia czopowego [Distribution of stress in the glue bond of mortise joint], Materials of the 6th Scientific Session Reaserch for Furniture Design, Poznań, 61-73.
9. Dziuba, T.; Kwiatkowski, K., 1976: Űber prűfung des berechnungsverfahrens fűr die konstruktion von stűhlen, Holztehnologie, 17 (1): 222-227.
10. Eckelman, C. A.; Suddarth, S. K., 1969: Analysis and design of furniture frames, Wood Sci. Tehnol., 3: 239-255.
11. Eckelman, C. A., 1970: The fatigue strength of two-pin moment – resisting dowel joints, Forest Products Journal, 20 (5): 42-45.
12. Eckelman, C. A., 1989: Holding strength of through-bolt with dowel-nut connections, Forest Products Journal, 39 (11-12): 41-48.

13. Erdil, Y. Z.; Zhang, J.; Eckelman, C. A., 2003: Withdrawal and bending strength of dowel-nuts in plywood and oriented strandboard, Forest Products Journal, 53 (6).
14. Ganowicz, R.; Nowak, K., 1976: Wybrane problemy konstrukcyjno – wytrzymałościowe projektowania mebli [Selected constructio-strength problems of furniture design], Rocz. AR Pozn., 81.
15. Gawrońsky, T., 2006: Rigidity-strength models and stress distribution in housed tenon joints subjected to torsion, Electronic journal of Polish Agricultural Universities, 9, 4.
16. Gogolin, R. M.; Wilczyński, A.; Warmbier, K., 1996: Naprężenia na powierzchni płaskiego połaczenia narożnikowego o złaczu kołkowym [Stress on the surface of flat corner connection with dowel joint], 8. Ses. Nauk. Badania dla meblarstwa, 45-59.
17. Hill, M. D.; Eckelman, C. A., 1973: Flexibility and bending strength of mortise and tenon joints, Furn. Design Manuf., 45 (1/2): 54-61.
18. Jeršić, R.; Sinković, B., 1978: Faktori kvalitete stolica, Drvna industrija, 29, 9, 227-234.
19. Kamenicky, J., 1975: Die Nachgiebigkeit von Zapfenverbindungen für Möbelkonstruk-tionen, Drev. Vysk., 20 (4): 197-214.
20. Kamenicky, J., 1982: Die verteilung der inneren kraefte in stuhlgestellen mit unterschiedlichen verbindungen, Holztehnologie, 23 (2): 103-107.
21. Korzeniowsky, A., 1968: Mozliwosci zwiekszania wytrzymalosci i sztywnosci klejonychzlaczy w ramowych i szkieletowych konstrukcjach stolarskich. Przemysl Drzewny, 2: 19-22.
22. Korzeniowsky, A., 1974: Kryteria unifikacji klejonych zlaczy naroznych. Przemysl Drzewny, 11: 21-24.
23. Korzeniowsky, A., 1984: The influence of fit on the mechanical properties of glued mortice and tenon joints. Ann. Warsaw Agricult. Univ. – SGGW – AR. Forest and Wood Technology, 31: 3-11.
24. Nakai, T.; Takemura, T., 1995: Stress analysis of through – tenon joint of wood under torsion I. Shear stress analysis of the male using the finite element method, J. Jap. Wood Res. Soc., 42 (4): 361-368.
25. Nakai, T.; Takemura, T., 1996: Stress Analysis of the throug-tenon joint of wood under torsion II. Measurements of shear stresses in the male by using Rosette gauges, Mokuzai Gakkaishi, 42 (4): 387-392.
26. Pellicane, P., 1994: Finite element analysis of finger – joints in lumber with dissimilar laminate stiffnesses, Forrest Products Journal, 44 (3): 17-22.
27. Prekrat, S.; Tkalec, S.; Grbac, I. 1998: Defining the criteria for technical Quality of wood structures at automatic furniture construction, Design 98, / Marjanović, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, WDK, Zürich 475-479.
28. Prekrat, S; Jazbec, A.; Pervan, S., 2004.: Analysis of the bending moment of innovative corner joints during static testing, Wood research, 49 (1): 21-32.
29. Richards, D.B., 1962: High-strength corner joints for wood. Forest Products Journal., 9: 413-418.
30. Smardzewski, J., 1991: Analiza odkształceń połaczen drewnianych [Technology of wood and wood compound materials], Springer-Verlag, Berlin.
31. Smardzewski, J., 1994: Model matematyczny i analiza numeryczna rozkładu naprężeń stycznych w prostokątnych spoinach połączen poddanych skręcaniu [Matematical model and numerical analysis of the distribution of tangential stresses in rectangular glue bonds of connections subjected to torsion], Materials of the 6th Scientific Session Reaserch for Furniture Design, Poznań, 31-35.
32. Smardzewski, J., 1996: Distribution of stresses in finger jonts, Wood Sci. Technol., 30: 477-489.
33. Smardzewski, J.; Dzięgielewski, S., 1996: Strength of wedge – shaped dovetail joints made from MDF boards, Materials of the 9th Scientific Session Reaserch for Furniture Design, Poznań, 11-21.
34. Smardzewski, J.; Papuga, T., 2004: Stress distribution in angle joints of skeleton furniture, Electronic journal of Polish Agricultural Universities, 7, 1.
35. Smardzewski, J.; Prekrat, S., 2004: Nelinearni model čvrstoće spoja svornjakom i zakretnim klinom, Drvna industrija, 55 (2): 59-67.
36. Smardzewski, J.; Ožarska, B., 2005: Rigidity of cabinet furniture with semi-rigid joints of the confirmat type, Electronic journal of Polish Agricultural Universities, 8, 2.
37. Smardzewski, J.; Grbac, I.; Prekrat, S., 2008: Nonlinear strength model of an eccentric joint mandrel, Drvna industrija, 59 (1): 2.
38. Tankut, A.N.; Tankut, N., 2004: Effect of Some Factors on Strength of Furniture Corner Joints Constructed with Wood Biscuits, Turk J. Agnric. For. 301-309, Tubiak.
39. Tkalec, S.; Prekrat, S., 2000: Konstrukcije proizvoda od drva – osnove drvnih konstrukcija, sveučilišni udžbenik, Znanje – Šumarski fakultet Sveučilišta u Zagrebu, 1-310.
40. Tkalec, S.; Prekrat S. 1997: Čvrstoća spojeva u konstrukcijama stolica od borovine i bukovine, Drvna industrija, 48 (1): 10 – 16.
41. Tkalec, S.; Prekrat, S.; Žmire, M. 1997: Ugaono spajanje bukovine klinastim zupcima, Drvna industrija, 48 (2): 79 – 85.
42. Vince, F., 1975: Zhodnotenie lepených nábytkových spojov z hľadiska ich pevnost a tuhost, Drevo, 30: 8-14.
43. Warmbier, K., 1999: Badania drewnianych połaczen katowych plaskich o wybranych zlaczach, Praca doktorska wykonana w Instytucie Techniki Wyzszej Szkoly Pedagogicznej w Bydgoszczy.
44. Wilczyński, A., 1988: Badanie naprężeń ścinających w spoinie klejowej w drewnie [Investigations of shear stress in wooden glue bond], University Publications of the WSP in Bydgoszcz.
45. Wilczyński, A.; Warmbier, K., 1996: Badania metodyczne połaczenia narożnikowego płaskiego o złaczu dwukołkowym [Metodical research of flat corner connection with double dowel joint], 9. Ses. Nauk. Badania dla meblarstwa, Poznań, 23-32.
46. Wilczyński, A.; Warmbier, K., 2003: Effect of joint dimensions on strength and stiffness of tenon joints, Folia Forestalia Polonica, Seria B, 34, 53-66.
47. Zhang, J.L.; Eckelman, C.A. 1993: The bending moment resistance of single- dowel corner joints in case construction, Forest Products Journal, 43 (6): 19 – 24.

Coresponding adress:

Assistant Professor SILVANA PREKRAT, PhD

Department of furniture and products of wood
Faculty of Forestry
University of Zagreb
Svetošimunska 25, p.p. 422
HR-10002 Zagreb, Croatia
e-mail: prekrat@sumfak.hr

Search wood technology science at

http://drvnaindustrija.sumfak.hr/

OSVRT NA 20. MEĐUNARODNO SAVJETOVANJE U SKLOPU AMBIENTE 2009.

U sklopu 36. međunarodnog sajma namještaja, unutrašnjeg uređenja i prateće industrije AMBIENTA 16. listopada 2009. godine održano je 20. jubilarno međunarodno savjetovanje pod naslovom DRVO JE PRVO - NOVI MATERIJALI, KVALITETA I DIZAJN PROIZVODA. Glavni organizatori savjetovanja bili su Šumarski fakultet, InnovaWood, Zagrebački velesajam, Hrvatsko šumarsko društvo, Znanstveno vijeće za poljoprivredu i šumarstvo HAZU, Akademija tehničkih znanosti Hrvatske i Akademija šumarskih znanosti. Ministarstvo regionalnog razvoja, šumarstva i vodnoga gospodarstva i ove je godine bilo glavni pokrovitelj savjetovanja. Druge godine zaredom glavni moto savjetovanja bio je DRVO JE PRVO, čime su se organizatori uključili u akciju koju je inicirala Gospodarska komora i resorno ministarstvo s ciljem povećanja uporabe drva i jačanja konkurentnosti domaće drvne industrije. Uz domaće stručnjake, na savjetovanju su sudjelovali gosti iz Bugarske, Slovenije i Poljske. Već treću godinu zaredom dio prihvaćenih radova predstavljen je usmeno - kratkim petnaestominutnim predavanjima u dvorani Brijuni, a dio radova predstavljen je putem postera u dvorani Vis-Korčula. Nakon pozdravnih riječi gospođe Katje Luke Kovačić u ime Zagrebačkog velesajma, gospodina akademika Zlatka Kniewalda u ime Akademije tehničkih znanosti Hrvatske i gospođe Renate Ojurović u ime Ministarstva regionalnog razvoja, šumarstva i vodnoga gospodarstva, prodekan Šumarskoga fakulteta izv. prof. dr. sc. Radovan Despot otvorio je savjetovanje. Prije početka radnog dijela savjetovanja urednica časopisa Drvna industrija prof. dr. sc. Ružica Beljo Lučić na poziv organizatora održala je kratko izlaganje u povodu 60. godišnjice izlaženja časopisa. U izlaganju je predstavila razvoj časopisa od 1949. godine do danas i naglasila kako je glavni cilj današnjeg Uredništva zadovoljiti kriterije za ulazak u bazu *Web of Science*.

Slika 1. Prodekan Šumarskoga fakulteta izv. prof. dr. sc. Radovan Despot

Slika 2. Pozdravni govor gospođe Katje Luke Kovačić

Prvo predavanje na savjetovanju *Novi materijali i tehnologije – izazov za suvremeni dizajn proizvoda od drva* održala je Danijela Domljan, diplomirana dizajnerica zaposlena na Šumarskom fakultetu. U radu se osvrnula na ulo-

Slika 3. Izlaganje doc. dr. sc. Silvane Prekrat

gu dizajnera u stvaranju dobrog proizvoda, na očekivanja suvremenog korisnika namještaja, te na novosti u materijalima i tehnologijama.

Rad *Primjenjivost MDF ploča u izradi lakiranih dovratnika* predstavila je Tajana Jambreković, dipl ing. drvne tehnologije, trenutačno zaposlena u Holzcluster Steiermark GmbH u Austriji. U radu su istraživani uzroci površinskih pukotina u lakiranim filmovima na bočnim površinama dovratnika izrađenih od MDF ploča. Ustanovljeno je da pukotine na ispitivanim pločama nisu površinske, već je pucanje lakiranog filma posljedica dubinskih pukotina u strukturi MDF ploča neadekvatnog tipa, odnosno da MDF ploče ne zadovoljavaju zahtjeve norme HRN EN 622-5. Tajana Jambreković, dipl. ing., naglasila je važnost izbora određenog tipa MDF ploča prema uvjetima upotrebe i istaknula važnost potpune zaštite poliuretanskim sustavom za površinsku obradu cijelog dovratnika, a ne samo vidljivih stranica, kako bi se onemogućila sorpcija vodene pare i vlage.

Izvanredna profesorica dr. Elena Pissareva sa Šumarskog fakulteta iz Bugarske održala je predavanje s naslovom *Dizajn kuhinjskog namještaja za osobe s invaliditetom*. Kolegica Pissareva je arhitektica i dala je pregled prevladavajućeg načina projektiranja kuhinja u Bugarskoj, a kao glavne probleme za invalidne osobe naglasila nedostatak prostora za kretanje kolica i problem nepristupačnosti kuhinjskim elementima. Predstavila je načine rješavanja navedenih problema i fleksibilna dizajnerska rješenja.

Rad *Utjecaj vrste i oblika svornjaka na krajnju savojnu čvrstoću i krutost kutnih vezova izrađenih od iverice* predstavio je izv. prof. dr. Vassil Jivkov sa Šumarskog fakulteta, Odsjeka za interijer i dizajn namještaja iz Bugarske. Kolega Jivkov predstavio je rezultate ispitivanja čvrstoće i krutosti za 15 grupa kutnih vezova izrađenih od iverice debljine 18 mm i spojenih različitim vrstama svornjaka. Vrsta svornjaka ima velik utjecaj na čvrstoću i krutost spoja. Dobiveni rezultati mogu koristiti proizvođačima svornjaka, namještaja i dizajnerima.

Docentica Silvana Prekrat sa Šumarskog fakulteta iz Zagreba predstavila je rad *Određivanje kriterija kvalitete namještaja u fazi projektiranja*. U predavanju je dala primjere međusobne interakcije materijala, konstrukcije i dizajna, te kriterije za određivanje optimalne kvalitete gotovog proizvoda. „Definiranje kvalitete proizvoda u fazi projektiranja donosi znatne uštede u vremenu izrade, a time i cjelokupnoj cijeni koštanja gotovog proizvoda“, istaknula je docentica Prekrat.

Rad *Usporedna analiza koeficijenata krutosti L i T kutnih sastava okvira od kestenovine* predstavila je izv. prof. dr. Assia Marinova iz Bugarske. Dr. Marinova istaknula je da vrsta sastava znatno utječe na njegovu krutost i da T-kutni sastav ima u prosjeku 7,6 % veći koeficijent krutosti nego L-sastav. Preporučila je da te podatke dizajneri i inženjeri uzmu u obzir pri izboru vrste kutnog spoja u konstrukcijama stolaca.

Mladi kolega Matija Jug, dipl. ing. drvne tehnologije, zaposlen kao znanstveni novak na Šumarskom fakultetu, održao je predavanje s naslovom *Značajke mehaničke obrade termički modificirane bukovine*. U radu je analiziran utjecaj posmične brzine i prsnog kuta reznog brida na svojstva usitnjenog drva, snagu rezanja i emisiju buke pri blanjanju. Rezultati su uspoređeni s rezultatima dobivenima mehaničkom obradom parene bukovine. Ustanovljeno je da je usitnjavanje termički

Slika 4. Izlaganje prof. dr. Vassila Jivkova

Slika 5. Izložba postera

modificirane bukovine veće od usitnjavanja parene bukovine u svim ispitivanim uvjetima obrade. Utjecaj posmične brzine na veličinu usitnjenih čestica veći je pri obradi parene bukovine nego pri obradi termički modificirane bukovine. Nasipna gustoća blanjevine zbog većeg udjela sitnijih čestica dva je do tri puta veća pri obradi termički modificirane bukovine nego pri obradi parene bukovine. Pri blanjanju termički modificirane bukovine izmjerena je i do 40 % manja snaga u usporedbi sa snagom pri blanjanju parene bukovine. Razina emitirane buke pri blanjanju proporcionalna je izmjerenoj snazi blanjanja.

U radu *Utjecaj drvnih spojeva na trajnost konstrukcije* izv. prof. dr. Jasna Hrovatin s Biotehniške fakultete iz Ljubljane iznijela je rezultate ispitivanja upojnosti vode i brzine sušenja šest različitih drvnih sastava pri umjetnom navlaživanju. Konstrukcijskim rješenjem može se utjecati na smanjenje upojnosti vode i osiguranje bržeg sušenja drvnih elemenata, što može utjecati na poboljšanje trajnosti drvnih proizvoda, ističe dr. Hrovatin.

U radu s naslovom *Kreativno rješavanje problema u dizajnu namještaja* Anna Lusiak, dipl. ing., s Fakulteta drvne tehnologije iz Poljske predstavila je metode krativnog rješavanja problema u dizajnu namještaja.

Dr. sc. Alan Antonović u radu *Utjecaj nekih parametara prešanja na svojstva ploča iverica modificiranih utekućenim drvom* iznio je rezultate istraživanja utjecaja nekih parametara prešanja na kompatibilnost utekućenog drva i KF smola, na polimernu strukturu i adhezijsko-kohezijska svojstva modificiranih KF ljepila, te na fizikalno-mehanička svojstva i emisiju formaldehida ploča iverica.

O utekućenom drvu govorio je i kolega Franc Budija, univ. dipl. inž. les. iz Slovenije. On je predstavio rad *Karakteristike samoumrežavajućih premaza izrađenih od utekućene smrekovine.* U radu su predstavljeni rezultati ispitivanja svojstava premaza dobivenih od utekućenog drva smrekovine, koji se pri povišenoj temperaturi mogu samo-umrežavati. Premazi su pokazali visok sjaj i bolju otpornost na tekućine nego komercijalni premazi, no slabiju fleksibilnost.

U pauzi usmenih izlaganja sudionici savjetovanja mogli su razgledati postere. Posterima je bilo predstavljeno deset radova. U obliku postera prezentirani su sljedeći radovi.

– Zoran Vlaović, Ivica Grbac, Danijela Domljan, Andrej Bublić: *Istraživanje deformacija i indeksa udobnosti uredskih radnih stolica*

U radu su istraživane deformacije sjedala i drugih konstrukcijskih dijelova stolaca poput cilindara i kotačića te je određen indeks udobnosti sjedala kao pokazatelj udobnosti za korisnika.

– Renata Ojurović: *Inovacije i dizajn, ključ rasta i konkurentnosti*

Rad pokazuje važnost ulaganja u inovacije i dizajn u izazovnim gospodarskim prilikama i daje kratki prikaz njihova stanja u hrvatskoj preradi drva i proizvodnji namještaja.

– Vladimir Jambreković, Nikola Španić, Alan Antonović, Marija Naglić: *Komparacija svojstava ploča iverica starije generacije i suvremenih ploča iverica*

Osnovni cilj istraživanja u tom radu bila je usporedba ploča iverica proizvedenih tijekom 1981. godine s današnjima. Ispitana su fizikalna i mehanička svojstva ploča te koncentracija slobodnog formaldehida u njima.

– Stjepan Pervan, Silvana Prekrat, Željko Gorišek, Sergej Medved, Aleš Straže: *Utjecaj promjene vlažnosti zraka na čvrstoću bukovih ploča od cjelovitog drva*

U radu je analizirana smicajna čvrstoća slijepljenih spojeva bukovine, kao i čimbenici koji utječu na nju, poput debljine drva, vlage zraka i načina termičke obrade drva. Na osnovi dosadašnjih znanstvenih spoznaja, analizirana su i svojstva bukovine koja su ključna za čvrstoću slijepljenog spoja.

– Andreja Pirc, Maja Moro, Ksenija Šegotić, Renata Ojurović: *Primjena dizajna u hrvatskoj proizvodnji namještaja*

Cilj rada bio je istražiti koliko se hrvatski proizvođači namještaja koriste dizajnom i razvijaju ga, koje sastavnice dizajna smatraju najvažnijima te u kojoj mjeri dizajn pomaže razvoju poduzeća i postizanju bolje konkurentnosti na domaćemu, ali i na međunarodnom tržištu.

– Ivica Župčić, Andrija Bogner, Ivica Grbac, Marin Hasan, Božidar Hrovat: *Nove spoznaje u istraživanju zavarivanja drva*

U radu su prikazane dosadašnje svjetske spoznaje, ali i rezultati vlastitih istraživanja utjecaja trajanja procesa zavarivanja na izvlačnu silu između bukova moždanika i podloge od bukovine.

– Marin Hasan, Miroslava Mamoòová, Radovan Despot, Jelena Trajković, Bogoslav Šefc: *Promjena kvalitete drva bijelog bora (Pinus sylvestris L.) uslijed biološkog razaranja gljivom smeđe truleži, Gloeophillum trabeum (Pers.: Fr.)*

Cilj rada bio je na temelju SEM analize uzoraka drva običnog bora, razgrađenih gljivom smeđe truleži *Gloeophillum trabeum*, provjeriti način penetracije gljive u drvo i mehanizam razgradnje drva, te predstaviti mogućnosti SEM analize u procjeni kvalitete drva.

– Josip Miklečić, Vlatka Jirouš-Rajković: *Novi materijali u površinskoj obradi drva*

U radu je dan pregled novih premaza i aditiva u površinskoj obradi kojima se zadovoljavaju ekološki propisi i postižu određena svojstva površina koja se konvencionalnim materijalima nisu mogla postići.

– Jelena Trajković, Bogoslav Šefc, Marin Hasan, Radovan Despot, Vedrana Horvat: *Utjecaj ispiranja na stabilnost dimenzija bukovine modificirane limunskom kiselinom*

U radu je naknadnim ispiranjem drva modificiranoga limunskom kiselinom provjerena postojanost kemijske veze limunske kiseline i hidroksilnih skupina drva.

– Jerzy Smardzewski, Silvana Prekrat, Stjepan Pervan: *Kontaktna naprezanja između sjedala i ljudskog tijela, usporedni rezultati numeričkog izračuna i eksperimenta*

Cilj rada bio je odrediti tvrdoću sjedala blagovaoničkog stolca, numerički izračunati kontaktna naprezanja između sjedala i ojastučenja, uz upotrebu dvaju tipova senzora, te usporediti rezultate laboratorijskog eksperimenta s rezultatima dobivenima računalnom simulacijom.

Svi radovi predstavljeni na savjetovanju u obliku predavanja ili u obliku postera objavljeni su u Zborniku radova na hrvatskome i engleskom jeziku, u izdanju Šumarskog fakulteta, na kojemu se mogu i nabaviti.

prof. dr. sc. Vlatka Jirouš-Rajković

Prezentacija studentskih radova na 36. Ambienti

Slika 1. Pozdravni govor dekana Šumarskog fakulteta izv. prof. dr. sc. Andrije Bognera

U sklopu događanja ovogodišnje 36. Ambiente, međunarodnog sajma namještaja, unutarnjeg uređenja i prateće industrije, prvi su put samostalno nastupili studenti Šumarskog fakulteta Sveučilišta u Zagrebu. Inicijativu je pokrenuo Studentski zbor Šumarskog fakulteta sa željom da studenti svoje znanstvene i stručne radove prezentiraju pred kolegama studentima, nastavnicima i stručnjacima drvnotehnološke struke. Uz veliku potporu Organizacijskog odbora Ambiente i profesora Šumarskog fakulteta, studenti su održali prezentaciju radova 14. listopada 2009. godine u dvorani Vis – Korčula na Zagrebačkom velesajmu. Da prvostupnici inženjeri drvne tehnologije mogu raditi ne samo stručne nego i znanstvene radove, uvjerilo se stotinjak nazočnih na prezentaciji studentski radova. Nakon uvodnoga govora moderatora prezentacije prodekana Šumarskog fakulteta izv. prof. dr. sc. Radovana Despota, zatim dekana Šumarskog fakulteta izv. prof. dr. sc. Andrije Bognera i predsjednika Studetnskog zbora Šumarskog fakulteta Ante Dubravca, studetni su započeli izlaganja.

Slika 2. Prisutni na prezentaciji studentskih radova

Studentice preddiplomskog studija Drvna tehnologija, Magdalena Adžić i Josipa Paleka prezentirale su znanstveni rad nagrađen Rektorovom nagradom pod naslovom *Doprinos optimizaciji režima modifikacije limunskom kiselinom*.

U radu su prezentirani rezultati istraživanja utjecaja modifikacije drva limunskom kiselinom na stabilnost dimenzija i optimiranje potrebnih parametara. Mjereni su porast mase drva zbog modifikacije, gubitak mase zbog ispiranja, učinak smanjenja bubrenja, učinak smanjenja utezanja. Ispitivano je drvo običnog bora, svi su uzorci pripremljeni prema normi DIN 52184. Za modifikaciju bjeljike običnog bora pripremljeno je šest koncentracija limunske kiseline i katalizatora natrij-hipofosfita u vodenoj otopini. Uzorci su impregnirani i termokondenzirani na različitim režimima temperatura i uz različito vrijeme trajanja. Porast mase zbog modifikacije drva limunskom kiselinom smanjuje se s povećanjem temperature termokondenzacije, što potvrđuje pretpostavku o bržem raspadanju i isparavanju katalizatora. Vrijeme termokondenzacije nije znatnije utjecalo na porast mase. Modifikacija limunskom kiselinom rezultira povećanjem stabilnosti dimenzija u odnosu prema prirodnom drvu. Pri ispiranju modificiranog drva u svim se grupama uzoraka smanjila stabilnost dimenzija.

Branimir Unger, student diplomskog studija Drvnotehnološki procesi prezentirao je završni rad s naslovom *Utjecaj koncentracije limunske kiseline i katalizatora na dimenzionalnu stabilnost pri modifikaciji borovine (Pinus sylvesytris L.)*.

U radu su prezentirani rezultati do sada provedenih istraživanja na području kemijske modifikacije drva limunskom kiselinom. Prezentirani su rezultati istraživanja utjecaja modifikacije drva limunskom kiselinom na stabilnost dimenzija i ispiranje, optimirane su koncentracije limunske kiseline i katalizatora. Mjereni su porast mase drva zbog modifikacije, gubitak mase zbog ispiranja, učinak smanjenja bubrenja, učinak smanjenja utezanja. Istraživano je drvo bjeljike bijelog bora. Uzorci su pripremljeni prema DIN 52184. Za modifikaciju bjeljike bijelog bora pripremljeno je šest koncentracija limunske kiseline i katalizatora natrij-hipofosfita u vodenoj otopini. Uzorci su impregnirani, a potom termokondenzirani na 140 °C tijekom deset sati. Porast mase zbog modifikacije drva limunskom kiselinom povećava se s povećanjem koncentracije limunske kiseline i katalizatora u vodenoj otopini.

Bruno Radotić, student diplomskog studija Drvnotehnološki procesi prezentirao je stručni rad *Izvedbe drvenih podova*.

Cilj rada bio je uputiti na neke od mogućih grešaka drvenih podova. Drvo kao prirodni materijal ima niz prednosti, npr. estetska svojstva, izolacijska svojstva, lagano održavanje i obnavljanje, odlična gazna svojstva, prihvatljivu cijenu, ekološku prihvatljivost i mogućnost jednostavne reciklaže. No ono ima i niz nedostataka: nepostojano je u određenim uvjetima, lako je zapaljivo, habanjem se troši površinski sloj, a najveći problem kada govorimo o drvu na podovima jest njegovo svojstvo higroskopnosti.

Higroskopnost je svojstvo drva da upija i otpušta vodu. Razlikujemo dvije vrste vode u drvu – slobodnu vodu (iznad TZV-a) te vezanu vodu (ispod TZV-a). Probleme stvara vezana voda, koja uzrokuje bubrenje i utezanje. Naime, drvo se nastoji prilagoditi uvjetima u koje ga postavimo. Svjesni smo da u prostorijama u koje ugrađujemo drvene podove tijekom godine dolazi do promjene uvjeta. Tako se u zimskim mjesecima, kada se prostorije griju centralnim grijanjem, zrak jako suši pa je njegova vlaga nerijetko oko 30 – 40 %, a ljeti, kada se otvaraju prozori i radijatori su zatvoreni, vlaga zraka teži izjednačenju s vanjskom, na više od 60 %. To donosi promjenu ravnotežnog sadržaja vode u drvnim podovima s približno 7 % u zimskim mjesecima na oko 11 % na kraju ljeta, što dovodi do promjene dimenzija bubrenjem i utezanjem.

Veliku pozornost treba pridati i uvjetima pri polaganju drvnih podnih elemenata. Odgovarajuća vlaga cementne podloge ključna je za nepojavljivanje grešaka, pa se predlaže strogo mjerenje vlage. Ako sadržaj vode prelazi 3 %, ugradnja je zabranjena, pri 2,5 – 3 % sadržaja vode ugradnja je rizična, uz 2 – 2,5 % ugradnja je dopuštena, a tek pri 1,5 – 2 % ugradnja je sigurna.

Pri polaganju drvnih podnih elemenata treba uzeti u obzir niz činjenica kao što su sadržaj vode u podlozi, ljepilu, drvnom elementu ili zraku, temperatura zraka, način polaganja, razmaci do zidova, vrste drva od kojih su izrađeni elementi itd.

Uzmu li se u obzir svi razlozi zbog kojih dolazi do grešaka na drvenim podovima, može se zaključiti da je za nastanak većine grešaka presudan ljudski faktor, na koji se može utjecati.

Sve kraći rokovi izgradnje stambenih i poslovnih prostora rezultiraju nepridavanjem dovoljne pozornosti uvjetima u koje će se drvo postaviti. Stoga autor rada predlaže da se više pozornosti prida mjerenjima sadržaja vode te načinima polaganja kako bi se pojava grešaka svela na minimum i na taj način ostvarila dugovječnost drvenih podova.

Studentica diplomskog studija Oblikovanje proizvoda od drva Marija Kajapi prezentirala je također stručni rad pod nazivom *Uloga boja u unutarnjem uređenju.*

Kada se govori o izražajnim sredstvima u arhitekturi, dizajnu ili umjetnosti valja reći sljedeće: ako postoji neki fenomen koji je oduvijek izazivao interes čovjeka i koji su stručnjaci pokušali definirati, to je svakako boja.

Boja kao fenomen posebice je značajna za ona područja arhitekture i dizajna u kojima se, osim estet-

Slika 3. Studentica Marija Kajapi pri izlaganju svojeg rada

skih zahtjeva, trebaju zadovoljiti i funkcionalni. Mnogi su stručnjaci sav svoj život proveli pokušavajući stvoriti određene sustave boja i utvrditi određene zakonitosti u međusobnim odnosima boje i čovjeka, njegovih reakcija i ponašanja. Namjera autorice nije bila raspravljati o teoriji boje u njezinim pojedinostima ili isticati prednosti nekog sustava već objasniti ulogu i primjenu boje u uređenju nekog prostora.

Iva Ištok, dipl. ing. drvne tehnologije, prezentirala je diplomski rad s naslovom *Dizajn suvremenog namještaja temeljen na tradiciji Hrvatskog zagorja.*

Činjenica da se u cijelom spektru suvremenih rješenja namještaja samo rijetko pronađu ona koja donekle sadržavaju neki tradicionalni element potaknula je autoricu da se u svom diplomskom radu bavi upravo tom tematikom. Stoga je u svom radu autorica, zbog svojega podrijetla i zanimanja za kulturnu i tradicijsku baštinu Hrvatskog zagorja, istraživala spomenutu tematiku u Muzeju Staro selo u Kumrovcu, koji je definiran terminom *in situ*, upotrebljavanim u etnološkoj terminologiji sa značenjem na istome mjestu. Naime, ni jedna kuća ni bilo koji drugi objekt nije preseljen iz drugog ambijenta, već je svaki obnovljen na starim temeljima, na mjestu na kojemu je izvorno sagrađen na prijelazu prošlog stoljeća te opremljen autentičnim predmetima svakidašnje upotrebe.

Autorica je nastojala definirati i prikazati koncept novog rješenja oblikovanog na suvremeni način te u skladu sa suvremenim zahtjevima i potrebama, a uz maksimalno zadržavanje oblikovnih i funkcionalnih tradicionalnih obilježja. Tema je odabrana s ciljem upozoravanja na važnost tradicije u današnjem vremenu brzih promjena i nametnutih trendova, a u nastojanju da taj rad naznači potrebu za implementacijom tradicijskih obilježja u suvremena rješenja. Također se očekuje da će rad pridonijeti stvaranju jasnije slike o pristupu oblikovanju suvremenog namještaja s temeljima u tradiciji.

Slika 4. Prezentacija Ive Ištok, dipl. ing. drvne tehnologije

Zadovoljni uspjehom na ovogodišnjoj Ambienti, članovi Studentskog zbora već su započeli pripreme za iduću Ambientu 2010. Želja im je da se osim studenata Drvnotehnološkog odsjeka Šumarskog fakulteta izlaganju radova pridruže i studenti Šumarskog odsjeka. Na taj bi se način još jače približile drvarska i šumarska struka te studentskim znanstvenim i stručnim radom naznačio zajednički put u budući napredak tih dviju perspektivnih struka.

Anto Dubravac, univ. bacc. ing. techn. lign.
predsjednik Studentskog zbora Šumarskog fakulteta

Ljubljanski pohištveni sejem 2009.

Od 3. do 8. studenog 2009. godine u Ljubljani je održan 20. Ljubljanski pohištveni sejem, koji je posjetilo 50 000 osoba. Na toj najvećoj priredbi u Sloveniji ove se godine na 18 000 m^2 predstavilo 326 poduzeća iz 23 države.

Podijeljene su i brojne nagrade među kojima se ističu nagrada za proizvode i sistemska rješenja *Top ten*, a dodijelila ju je međunarodna komisija koju su činili Steve Diskin, Isabel Herault, Špela Hudnik, Thomas Machhörndl, Vladimir Pozdirc i Janez Koželj. Kriterij za izbor nagrađenih komisija je donijela na temelju kreativnosti, koja najbolje udružuje funkcionalnost te tehnološku i likovnu kvalitetu. Nagradom *Top ten* nagrađeni su:

– ETIS d.o.o. Ljubljana, za kuhinjsku napu ELICA OM SPECIAL EDITION, Elica team design
– IKONA ARHITEKTURA d.o.o. i POHIŠTVO APAČE d.o.o., za sobu za djecu i mladež Flex, Barbara Selinšek
– KOLPA d.d., METLIKA, za stol Simple, Gordana Marinko Vinski
– LIP RADOMLJE d.d., za stol i klupu East Village XXX, X PAND, Austrija
– MAREMICO d.o.o., za patentirani modularni ležaj Leticia, Tine in Emil Marinšek
– ODEJA d.o.o., za kolekciju Nostalgia, Maja Tomažič
– OSM POHIŠTVO d.o.o., za dječji namještaj Živahne životinje – Slon, BOLETTE BLÆDEL IN LOUISE BLÆDEL
– PARON d.o.o., za stolicu Waati Orpheus, Vasja Grabner
– POBLES d.o.o, za kuhinju Partes, Mateja Cukala
– SVEA LESNA INDUSTRIJA, d.d., za kuhinju Tulipana 3, Darko Šurina.

Slika 1. Stolica Waati Orpheus

Od svih navedenih nagrada izabran je najbolji *Top ten* proizvod – kuhinja Partes proizvođača POBLES d.o.o., koja je izrađena od malih dužinsko-širinski spojenih dijelova otpadnog furnira. Posebnost te kuhinje čine staklena pročelja ladica s unutarnjim osvjetljenjem, što zamjenjuje vitrinu, a tako osvijetljene ladice čine ambijent posebnim. Ladice na pultu otvaraju se s obje strane, iz kuhinjskoga i blagovaoničkog prostora. Prostor između donjih i gornjih ormarića kuhinje, kao i donožje, obloženi su oblogom od nehrđajućeg čelika. Kuhinja je podijeljena na nekoliko cjelina koje čine prostor za kuhanje, pripremu hrane, objedovanje te odlaganje vinskih boca i čaša.

Tradicionalno su dodijeljena i tri posebna priznanja za najljepši izlagački prostor, koje su pripale:

– Donaru d.o.o., za estetsko oblikovan i grafički dovršen izložbeni prostor
– Kolpi d.d., Metlika za tehnološko dovršen i oblikovno dizajniran prostor,
– Vili Bravum, za uspješnu suradnju 17 proizvođača na ambicioznom i zahtjevnom projektu, koji je posjetiteljima predstavio ambijente unutarnjih i vanjskih prostora.

Ove je godine jedna od nagrada pripala i studentici Ajdi Kranjc za kuhinju Multi-Line. Projekt su vodili doc. dr. sc. Tomaž Novljan, u.d.i.a. (Fakulteta za arhitekturo), doc. dr. sc. Jasna Hrovatin (Visoka šola za dizajn), Boštjan Podlesnik, u.d.i.l., postdiplomant i Andrej Erjavec, direktor Mizarstva Erjavec.

Nagrada *Zlata vez*, koju dodjeljuju Gospodarsko rastavišče i Združenje lesne in pohištvene industrije pri GSZ, dodijeljena je:

Slika 2. Pročelja ormara s tiskanim ornamentima na staklu

Slika 3. Kuhinja Multi-Line

Slika 4. Stol East Willage XXX

– prva nagrada - Alples, d.d., za spavaću sobu *Samba* Marjane Rejc
– druga nagrada - Svea lesna industrija, d.d. za kuhinjski program *Tulipan* Darka Šurine
– treća nagrada - Mizarstvo Erjavec Andrej s.p., za kuhinju Multi-Line autorice Ajde Kranjc.

U sklopu sajma održan je i *Arhitekturni dijalog*, besplatno osobno savjetovanje o unutarnjem uređenju, provedeno na unaprijed postavljenim podlogama od standardnih pitanja. Raspis natječaja za prikupljanje projektnih zadataka trajao je od 6. svibnja do 31. lipnja 2009. Studenti arhitekture pod mentorstvom su izveli rješenja za nekoliko projektnih zahtjeva koji su bili odabrani između 144 pristigla.

Slika 5. Ormarić kuhinje Partes

Slika 6. Dječji namještaj živahne životinje

Slika 7. Prijedlog uređenja jednosobnog stana za studente, rad Barbare Škraba, uz mentorstvo dr. Špele Hudnik

Stručna predavanja koja su održana unutar sajma namještaja obuhvatila su različite teme s područja namještaja i interijera. Dana 3. studenog održan je okrugli stol s naslovom *Kako do dodatne vrijednosti u industriji namještaja*, 4. studenog bio je rezerviran za predavanja o zdravom spavanju i izboru ležaja, dok se u četvrtak 5. studenoga raspravljalo o konkurentnosti na tržištu i očuvanju okoliša.

doc. dr. sc. Silvana Prekrat

Slika 8. Stol Simple

Manio

NAZIVI I NALAZIŠTE

Drvo manio, maniu, manilihuan potječe iz Južne Amerike, uglavnom iz Čilea i Argentine između 36. i 42. južne paralele. Pod tim nazivom u trgovinu dolaze uglavnom vrste *Podocarpus nubigenus* Lindl. i *P. salignus* D. Don., zajedno s drvom botaničke vrste *Saxegothaea conspicua* Lindl., koje je slično drvu *Podocarpus* spp. Navedene vrste pripadaju porodici *Podocarpaceae.* Uz manio, u upotrebi su i naziv yellowwood (SAD) i sisin (Ekvador).

STABLO

Visine pojedinih stabala kreću se od 9 do 24 m, a prsnog su promjera od 45 do 75 cm. Deblo *P. nubigenus* obično je pravilnijeg oblika od ostalih navedenih vrsta koje često imaju iskrivljena i usukana debla. Kora stabla je glatka, tamnosiva do crna, s unutarnje strane crvenkasta.

DRVO

Makroskopska obilježja

Drvo je svjetlo žućkastosmeđe, s neobojenom srži. Tekstura mu je jednolična. Tangentni presjeci imaju blage valovite crte, a radijalni blage crte malo tamnijega kasnog drva.

Granice godova slabo su uočljive, prijelaz iz ranoga u kasno drvo unutar goda je postupan. Kasno je drvo neznatno tamnije od ranoga.

Mikroskopska obilježja

Drvo *Podocarpus* spp. nema smolenica. Traheide su mu na poprečnom presjeku poredane u pravilnim radijalnim nizovima. Kasno drvo čine 3 do 4 tangentno spljoštene aksijalne traheide kasnog drva. Udjel kasnog drva općenito je malen i kreće se od 2,7 do 4,8 %. Debljina stijenki aksijalnih traheida iznosi od 2,3 do 3,4 mikrometara, a širina lumena od 9 do 24 mikrometara. Aksijalne su traheide duge od 1,41 do 3,18 mm, a njihov je volumni udjel u drvu od 87 do 91 %.

Aksijalni parenhim raspoređen je difuzno ili u kratkim tangentnim nizovima. Volumni udjel u drvu mu je od 1,5 do 3 %.

Drvni traci raspoređeni su difuzno i nemaju traheide trakova. Visoki su od 1 do 12 stanica, široki 1 stanicu. Gustoća im je od 7 do 14 po milimetru tangentnog smjera, a volumni udjel trakova u drvu iznosi od 8 do 10%. Jažice polja ukrštanja taksodioidne su.

Fizikalna svojstva

Gustoća u apsolutno suhom stanju	450...500...560 kg/m^3
Gustoća u prosušenom stanju	500...540...600 kg/m^3
Gustoća u sirovu stanju	oko 1000 kg/m^3
Poroznost	oko 67 %
Totalno radijalno utezanje	oko 4,6 %
Totalno tangentno utezanje	oko 8,1 %
Totalno volumno utezanje	oko 13,1 %

Mehanička svojstva

Čvrstoća na tlak	42,5...47...51,7 (55,5) MPa
Čvrstoća na savijanje	87...105...115 MPa
Čvrstoća na vlak paralelno s vlakancima	57...80...116 (140) MPa
Tvrdoća prema Brinellu paralelno s vlakancima	43...52...57 MPa
Tvrdoća prema Brinellu okomito na vlakanca	20...23...25 MPa
Modul elastičnosti	9...9,9...10,9 GPa

TEHNOLOŠKA SVOJSTVA

Obradivost

Drvo manio lako se obrađuje oštrim alatima. Dobro drži čavle i vijke. Moguće ga je zadovoljavajuće dobro površinski obraditi. Dobro se lijepi.

Sušenje

Preporučuje se polagani režim sušenja jer drvo ima tendenciju pucanja i krivljenja.

Trajnost i zaštita

Manio drvo nije prirodno trajno. Može se lako impregnirati zaštitnim sredstvima.

Uporaba

Drvo manio upotrebljava se u stolariji, za izradu podova te u bačvarstvu. Može poslužiti kao zamjena za borovinu (*Pinus sylvestris* L.).

Napomena

Postoji oko sto vrsta roda *Podocarpus* koji proizvode drvo manje ili više svojstava sličnih drvu manio. Drvo je prirodno rasprostranjeno većinom na planinskim predjelima tropskoga i suptropskog pojasa Južne polutke. Vrste tog roda zastupljene su na tri velika biljna područja: 1. jugoistoku Azije, u Oceaniji i Australiji; 2. u tropskoj Africi i na Madagaskaru; 3. u Srednjoj i Južnoj Americi.

Literatura

1. The Timber Research and Development Association (TRADA), 1979: Timbers of the world, The Construction Press Ltd., Lancaster, England, 242-243.
2. Vidaković, M., 1982: Četinjače. JAZU, Sveučilišna naklada Liber, Zagreb, 576-579.
3. Wagenführ, R.; Scheiber, C., 1974: Holzatlas. WEB Fachbuchverlag, Leipzig, 648-650.
4. *** Wood dictionary, Elsevier publishing company, Amsterdam, 1964
5. *** Woods of the world, 1994, Tree talk, Inc., 431 Pine Street, Burlington, VT 05402.

izv. prof. dr. sc. Jelena Trajković
dr. sc. Bogoslav Šefc

Upute autorima

Sve autore molimo da prije predaje rukopisa pažljivo prouče sljedeća pravila. To će poboljšati suradnju urednika i autora te pridonijeti skraćenju razdoblja od predaje do objavljivanja radova. Rukopisi koji budu odstupali od ovih odredbi i ne budu udovoljavali formalnim zahtjevima bit će vraćeni autorima radi ispravaka, i to prije razmatranja i recenzije.

Opće odredbe

Časopis "Drvna industrija" objavljuje izvorne znanstvene i pregledne radove, prethodna priopćenja, stručne radove, izlaganja sa savjetovanja, stručne obavijesti, bibliografske radove, preglede te ostale priloge s područja iskorištavanja šuma, biologije, kemije, fizike i tehnologije drva, pulpe i papira te drvnih proizvoda, uključivši i proizvodnu, upravljačku i tržišnu problematiku u drvnoj industriji.

Predaja rukopisa razumijeva uvjet da rad nije već predan negdje drugdje radi objavljivanja i da nije već objavljen (osim sažetka, dijelova objavljenih predavanja ili magistarskih radova odnosno disertacija; što mora biti navedeno u napomeni); da su objavljivanje odobrili svi suautori (ako ih ima) i ovlaštene osobe ustanove u kojoj je rad proveden. Kad je rad prihvaćen za objavljivanje, autori pristaju na automatsko prenošenje izdavačkih prava na izdavača te pristaju da rad ne bude objavljen drugdje niti na drugom jeziku bez odobrenja nositelja izdavačkih prava.

Znanstveni i stručni radovi objavljuju se na hrvatskome uz širi sažetak na engleskome ili njemačkome, ili se pak rad objavljuje na engleskome ili njemačkome, s proširenim sažetkom na hrvatskom jeziku. Naslovi i svi važni rezultati trebaju biti dani dvojezično. Ostali se članci uglavnom objavljuju na hrvatskome. Uredništvo osigurava inozemnim autorima prijevod na hrvatski. Znanstveni i stručni radovi podliježu temeljitoj recenziji bar dvaju izabranih recenzenata. Izbor recenzenata i odluku o klasifikaciji i prihvaćanju članka (prema preporukama recenzenata) donosi Urednički odbor.

Svi prilozi podvrgavaju se jezičnoj obradi. Urednici će zahtijevati od autora da prilagode tekst preporukama recenzenata i lektora, a urednici zadržavaju i pravo da predlože skraćivanje i poboljšanje teksta.

Autori su potpuno odgovorni za svoje priloge. Podrazumijeva se da je autor pribavio dozvolu za objavljivanje dijelova teksta što je već negdje drugdje objavljen, te da objavljivanje članka ne ugrožava prava pojedinca ili pravne osobe. Radovi moraju izvještavati o istinitim znanstvenim ili tehničkim postignućima. Autori su odgovorni za terminološku i metrološku usklađenost svojih priloga.

Radovi se, u dva tiskana primjerka i u elektronskom zapisu, šalju na adresu:

Uredništvo časopisa "Drvna industrija"
Šumarski fakultet Sveučilišta u Zagrebu
Svetošimunska 25, HR - 10000 Zagreb
E-mail: drind@sumfak.hr

Rukopisi

Predani rukopisi smiju sadržavati najviše 15 jednostrano pisanih DIN A4 listova s dvostrukim proredom (30 redaka na stranici), uključivši i tablice, slike i popis literature, dodatke i ostale priloge. Dulje članke je preporučljivo podijeliti u dva ili više nastavaka.

Tekst treba biti napisan u MS Wordu, u normalnom stilu bez dodatnog uređenja teksta. Uredništvo prihvaća elektronski zapis na disketi, CD-u ili putem elektronske pošte.

Prva stranica poslanog rada treba sadržavati puni naslov, ime(na) i prezime(na) autora, podatke o zaposlenju (ustanova, grad i država), te sažetak s ključnim riječima (približno 1/2 DIN A4 stranice, u obliku bibliografskog sažetka).

Znanstveni i stručni radovi na sljedećim stranicama trebaju imati i naslov, prošireni sažetak i ključne riječi na jeziku različitom od onoga na kojem je pisan tekst članka (npr. za članak pisan na engleskome ili njemačkome naslov, prošireni sažetak i ključne riječi trebaju biti na hrvatskome, i obratno). Prošireni sažetak (približno 1 1/2 stranice DIN A4), uz rezultate, trebao bi omogućiti čitatelju koji se ne služi jezikom kojim je pisan članak potpuno razumijevanje cilja rada, osnovnih odrednica pokusa, rezultata s bitnim obrazloženjima te autorovih zaključaka.

Posljednja stranica sadrži titule, zanimanje, zvanje i adresu (svakog) autora, s naznakom osobe s kojom će Uredništvo biti u vezi.

Znanstveni i stručni radovi moraju biti sažeti i precizni, uz izbjegavanje dugačkih uvoda. Osnovna poglavlja trebaju biti označena odgovarajućim podnaslovima. Napomene se ispisuju na dnu pripadajuće stranice, a obrojčuju se susljedno. One koje se odnose na naslov označuju se zvjezdicom, a ostale natpisnim (uzdignutim) arapskim brojkama. Napomene koje se odnose na tablice pišu se ispod tablice, a označavaju se uzdignutim malim pisanim slovima abecednim redom.

Latinska imena pisana kosim slovima trebaju biti podcrtana.

U uvodu treba definirati problem i, koliko je moguće, predočiti granice postojećih spoznaja, tako da se čitateljima koji se ne bave područjem o kojemu je riječ omogući razumijevanje namjera autora.

Materijal i metode trebaju biti što preciznije opisane da omoguće drugim znanstvenicima obnavljanje pokusa. Glavni eksperimentalni podaci trebaju biti dvojezično navedeni.

Rezultati trebaju obuhvatiti samo materijal koji se izravno odnosi na predmet. Obvezatna je primjena metričkog sustava. Preporučuju se SI jedinice. Rjeđe rabljene fizikalne vrijednosti, simboli i jedinice trebaju biti objašnjeni pri prvom spominjanju u tekstu. Za pisanje formula koristiti Equation Editor (program za pisanje formula unutar MS Worda). Jedinice se pišu normalnim (uspravnim) slovima, a fizikalni simboli i faktori kosim slovima. Formule se susljedno obrojčavaju arapskim brojkama u zagradama, npr. (1) na kraju retka.

Broj slika mora biti ograničen na samo one koje su prijeko potrebne za pojašnjenje teksta. Isti podaci ne smiju biti navedeni u tablici i na slici. Slike i tablice trebaju biti zasebno obrojčene arapskim brojkama, a u tekstu se na njih upućuje jasnim naznakama ("tablica 1" ili "slika 1"). Naznaka željenog položaja tablice ili slike u tekstu treba biti navedena na margini. Svaka tablica i slika treba biti prikazana na zasebnom listu, a njihovi naslovi moraju biti tiskani na posebnim listovima, i to redoslijedom. Naslovi, zaglavlja, legende i sav ostali tekst u slikama i tablicama treba biti pisan hrvatskim i engleskim ili hrvatskim i njemačkim jezikom.

Slike i tablice trebaju biti potpune i jasno razumljive bez pozivanja na tekst priloga. Naslove slika i crteža ne pisati velikim tiskanim slovima. Uputno je da crteži odgovaraju stilu časopisa i da budu tiskani na laserskom printeru. Tekstu treba priložiti izvorne crteže ili fotografske kopije. Slova i brojke moraju biti dovoljno veliki da budu lako čitljivi nakon smanjenja širine slike ili tablice na 160 ili 75 mm. Fotografije trebaju biti crno-bijele; one u boji tiskaju se samo na poseban zahtjev, a trošak tiskanja u boji podmiruje autor. Fotografije i fotomikrografije moraju biti izvedene na sjajnom papiru s jakim kontrastom. Fotomikrografije trebaju imati naznaku uvećanja, poželjno u mikrometrima. Uvećanje može biti dodatno naznačeno na kraju naslova slike, npr. "uvećanje 7500 : l".

Svaka ilustracija na poleđini treba imati svoj broj i naznaku orijentacije te ime (prvog) autora i skraćeni naslov članka. Originalne se ilustracije ne vraćaju autorima.

Diskusija i zaključak mogu, ako autori tako žele, biti spojeni u jedan odjeljak. U tom tekstu treba objasniti rezultate s obzirom na problem koji je postavljen u uvodu u odnosu prema odgovarajućim zapažanjima autora ili drugih istraživača. Valja izbjegavati ponavljanje podataka već iznesenih u odjeljku "Rezultati". Mogu se razmotriti naznake za dalja istraživanja ili primjenu. Ako su rezultati i diskusija spojeni u isti odjeljak, zaključke je nužno iskazati odvojeno.

Zahvale se navode na kraju rukopisa.

Odgovarajuću **literaturu** treba citirati u tekstu i to prema harvardskom ("ime - godina") sustavu, npr. (Bađun, 1965). Nadalje, bibliografija mora biti navedena na kraju teksta, i to abecednim redom prezimena autora, s naslovima i potpunim navodima bibliografskih referenci. Nazive časopisa treba skratiti prema publikacijama Biological Abstracts, Chemical Abstracts, Forestry Abstracts ili Forestry Products Abstracts. Popis literature mora biti selektivan, osim u preglednim radovima. Primjeri navođenja:

Članci u časopisima: Prezime autora, inicijal(i) osobnog imena, godina: naslov. Skraćeni naziv časopisa, godište (ev. broj): stranice (od - do). Primjer: *Bađun, S. 1965: Fizička i mehanička svojstva hrastovine iz šumskih predjela Ludbrenik, Lipovljani. Drvna ind. 16 (1/2): 2 - 8.*

Knjige: Prezime autora, inicijal(i) osobnog imena, godina: naslov. (ev. izdavačeditor): izdanje (ev. tom). Mjesto izdavanja, izdavač, (ev. stranice od - do).

Primjeri:

Krpan, J. 1970: Tehnologija furnira i ploča. Drugo izdanje. Zagreb: Tehnička knjiga.

Wilson, J.W.; Wellwood, R.W. 1965: Intra-increment chemical properties of certain western canadian coniferous species. U: W. A. Cote, Jr. (Ed.): Cellular Ultrastructure of Woody Plants. Syracuse, N.Y., Syracuse Univ. Press, pp. 551- 559.

Ostale publikacije (brošure, studije itd.):

Müller, D. 1977: Beitrag zür Klassifizierung asiatischer Baumarten. Mitteilung der Bundesforschungsanstalt für Forst- und Holzvvirtschaft Hamburg, Nr. 98. Hamburg: M. Wiederbusch.

Tiskani slog i primjerci

Autoru se prije konačnog tiska šalju po dva primjerka tiskanog sloga. Jedan primjerak treba pažljivo ispraviti upotrebom međunarodno prihvaćenih oznaka. Ispravci su ograničeni samo na tiskarske greške: dodaci ili promjene teksta posebno se naplaćuju. Autori znanstvenih i stručnih radova primaju besplatno po pet primjeraka časopisa. Autoru svakog priloga dostavlja se po jedan primjerak časopisa.

Instructions for authors

The authors are requested to observe carefully the following rules before submitting a manuscript. This will facilitate co-operation between the editors and authors and help to minimise the publication period. Manuscripts that differ from the specifications and do not comply with the formal requirements will be returned to the authors for correction before review.

General

The "Drvna industrija" ("Wood Industry") journal publishes original scientific and review papers, short notes, professional papers, conference papers, reports, professional information, bibliographical and survey articles and general notes relating to the forestry exploitation, biology, chemistry, physics and technology of wood, pulp and paper and wood components, including production, management and marketing aspects in the woodworking industry.

Submission of a manuscript implies that the work has not been submitted for publication elsewhere or published before (except in the form of an abstract or as part of a published lecture, review or thesis, in which case that must be stated in a footnote); that the publication is approved by all co-authors (if any) and by the authorities of the institution where the work has been carried out. When the manuscript is accepted for publication the authors agree to the transfer of the copyright to the publisher and that the manuscript will not be published elsewhere in any language without the consent of the copyright holders.

The scientific and technical papers should be published either in Croatian, with extended summary in English or German, or in English or German with extended summary in Croatian. The titles and all the relevant results should be presented bilingually. Other articles are generally published in Croatian. The Editor's Office provides the translation into Croatian for foreign authors.

The scientific and professional papers are subject to a thorough review by at least two selected referees. The Editorial Board makes the choice of reviewers, as well as the decision about the accepting of the paper and its classification - based on reviewers' recommendations - is made by Editorial Board.

All contributions are subject to linguistic revision. The editors will require authors to modify the text in the light of the recommendations made by reviewers and linguistic advisers. The editors reserve the right to suggest abbreviations and text improvements.

Authors are fully responsible for the contents of their contribution. The Editors assume that the author has obtained the permission for the reproduction of portions of text published elsewhere, and that the publication of the paper in question does not infringe upon any individual or corporate rights. Papers must report on true scientific or technical progress. Authors are responsible for the terminological and metrological consistency of their contribution.

The contributions are to be submitted in duplicate printout and an electronic version to the following address:

Editorial Office "Drvna industrija"
Faculty of Forestry, Zagreb University
Svetošimunska 25, HR - 10000 Zagreb, Croatia
E-mail: drind@sumfak.hr

Manuscripts

Submitted manuscripts must consist of no more than 15 single-sided DIN A-4 sheets of 30 double-spaced lines, including tables, figures and references, appendices and other supplements. It is advised that longer manuscripts be divided into
two or more continuing series.

Manuscripts should be written in MS Word, in normal style. Electronic version on diskettes, CD or sent by e-mail will be accepted with the printout.

The first page of the typescript should present full title, name(s) of author(s) with professional affiliation (institution, city and state), abstract with keywords in the main language of the paper (approx. 1/2 sheet DIN A4, concise in abstract form).

The succeeding pages of scientific and professional papers should present a title and extended summary with keywords in a language other than the main language of the paper (e.g. for a paper written in English or German, the title, extended summary and keywords should be presented in Croatian, and vice versa). The extended summary (approx. 1 1/2 sheet DIN A4), along with the results, should enable the reader who is unfamiliar with the language of the main text, to completely understand the intentions, basic experimental procedure, results with essential interpretation and conclusions of the author.

The last page should provide the full titles, posts and address(es) of (all) the author(s) with indication as to whom of the authors are editors to contact. Scientific and professional papers must be precise and concise and avoid lengthy introductions. The main chapters should be characterised by appropriate headings.

Footnotes should be placed at the bottom of the same page and consecutively numbered. Those relating to the title should be marked by an asterix, others by superscript arabic numerals. Footnotes relating to the tables should be printed below the table and marked by small letters in alphabetical order. Latin names to be printed in italic should be underlined.

Introduction should define the problem and if possible the frame of existing knowledge, to ensure that readers not working in that particular field are able to understand author's intentions.

Materials and methods should be as precise as possible to enable other scientists to repeat the work. Main experimental data should be presented bilingually.

Results: only material pertinent to the subject can be included. The metric system must be used. SI units are recommended. Rarely used physical values, symbols and units should be explained at their first appearance in the text. Formulas should be written by using Equation Editor in MS Word. Units are written in normal (upright) letters, physical symbols and factors are written in italics. Formulas are consecutively numbered with arabic numerals in parenthesis (e.g. (1)) at the end of the line.

The number of figures must be limited to those absolutely necessary for clarification of the text. The same information must not be presented in both a table and a figure. Figures and tables should be numbered separately with arabic numerals, and should be referred to in the text with clear remarks ("Table 1" or "Figure 1"). The position of the figure or a table in the text should be indicated on the margin. Each table and figure should be presented on a single separate sheet. Their titles should be typed on a separate sheet in consecutive order. Captions, headings, legends and all the other text in figures and tables should be written in both Croatian and in English or German.

Figures and tables should be complete and readily understandable without reference to the text. Do not write the captions to figures and drawings in block letters.

Line drawings should, if possible conform to the style of the journal and be printed on the laser printer. Original drawings or photographic copies should be submitted with the manuscript. Letters and numbers must be sufficiently large to be readily legible after reduction of the width of a figure/table to either 160 mm or 75 mm. Photographs should be black/white. Colour photographs will be printed only on special request; the author will be charged for multicolour printing.

Photographs and photomicrographs must be printed on highgloss paper and be rich in contrast. Photomicrographs should have a mark indicating magnification, preferably in micrometers. Magnification can be additionally indicated at the end of the figure title (e.g. Mag. 7500:1). Each illustration should carry on its reverse side its number and indication of its orientation, along with the name of (principal) author and a shortened title of the article. Original illustrations will not be returned to the author.

Discussion and conclusion may, if desired, be combined into one chapter. This should interpret results in relation of the problem as outlined in the introduction and of related observations by the author(s) or others. Avoid repeating the data already presented in the "Results" chapter. Implications for further studies or application may be discussed. Aconclusion should be added if results and discussion are combined.

Acknowledgements are presented at the end of manuscript.

Relevant **literature** must be cited in the text according to the name - year (Harvard-) system. In addition, the bibliography must be listed at the end of the text in alphabetical order of the author' s names, together with the title and full quotation of the bibliographical reference. Names of journals should be abbreviated according to Biological Abstracts, Chemical Abstracts, Forestry Abstracts or Forest Products Abstracts. The list of references should be selective, except in review papers. Examples of the quotation:

Journal articles: Author, initial(s) of the first name, year: Title. Abbreviated journal name, volume (ev. issue): pages (from - to). Example;

Porter, A.W. 1964: On the mechanics of fracture in wood. For. Prod. J. 14 (8):325 - 331.

Books: Author, first name(s), year: Title. (ev. editor): edition, (ev. volume), place of edition, publisher (ev. pages from - to). Examples:

Kollmann, F. 1951: Technologie des Holzes und der Hokwerkstoffe. 2nd edition, Vol. 1. Berlin, Göttingen, Heidelberg: Springer

Wilson, J.W.; Wellwood, R.W. 1965: Intra-increment chemical properties of certain western Canadian coniferous species. In: W.A. Côte, Jr. (Ed.): Cellular Ultrastructure of Woody Plants. Syracuse, N.Y., Syracuse Univ. Press, pp. 551-559.

Other publications (brochures, reports etc.):

Müller, D. 1977: Beitrag zur Klassifizierung asiatischer Baumarten. Mitteilung der Bundesforschungsanslalt für Forst- und Holzwirtschaft Hamburg, Nr. 98. Hamburg: M. Wiederbusch.

Proofs and journal copies

Galley proofs are sent to the author in duplicate. One copy should be carefully corrected, using internationally accepted symbols. Corrections should be limited to printing errors; amendments to or changes in the text will be charged.

Authors of scientific and professional papers will receive 5 copies of the journal free of charge. Acopy of a journal will be forwarded to each contributor.

SVEUČILIŠTE U ZAGREBU
ŠUMARSKI FAKULTET
Svetošimunska cesta 25, Zagreb - ž.r. 2360000 - 1101340148 MB 3281485
tel: 00385(0)1/235 - 2478 fax:00385(0) 1/ 235- 2528

PRETPLATNI LIST

Izašao je broj 4 časopisa Drvna industrija, volumen 60, a uskoro tiskamo i prvi broj volumena 61. Pozivamo Vas da obnovite svoju pretplatu ili se pretplatite, ako do sada još niste, na časopis za volumen 61, te na taj način pomognete njegovo izlaženje. Cijena sva četiri broja jednog godišta (volumena) je 300,00 kn u Hrvatskoj, odnosno 55 EURA u inozemstvu. Ukoliko ste suglasni s uvjetima i cijenom pretplate na cjelokupno godište časopisa molimo Vas da popunite obrazac na poleđini i pošaljete ga na fax broj: +385/1/235 2 528 ili na adresu:

ČASOPIS DRVNA INDUSTRIJA
Šumarski fakultet Zagreb, Svetošimunska cesta 25
HR-10000 Zagreb
Hrvatska

Predsjednik Izdavačkog savjeta
časopisa Drvna industrija

prof. dr. sc. Ivica Grbac v.r.

Glavni i odgovorni urednik
časopisa Drvna industrija

prof. dr. sc. Ružica Beljo Lučić

ČASOPIS "DRVNA INDUSTRIJA"

Cjenik oglašavanja za 2010. godinu
ADVERTISING PRICE LIST FOR 2010

1/1 A4 stranica na drugoj, trećoj i četvrtoj strani ovitka ....4.550,00 kn
1/1 A4 stranica na prvim i zadnjim stranicama do ovitka ....4.300,00 kn
1/1 A4 stranica na drugim mjestima ....3.800,00 kn
1/2 A4 stranice na drugim mjestima ....2.700,00 kn
1/4 A4 stranice na drugim mjestima ....2.050,00 kn

Ovitak, kao i prve i zadnje stranice do ovitka tiskaju se u boji. Za oglas tiskan u dva ili više susjednih brojeva odobravamo popust 20%.

1/1 A4 Page on the second, third and fourth cover pages ....910 EUR
1/1 A4 Page on two first inner pages....................860 EUR
1/1 A4 Page on other places ....760 EUR
1 A4 Page on other places ....540 EUR
1/4 A4 Page on other places ....540 EUR

Cover and first inner pages are printed in colour. For 2 advertisements published in successive issues a discount of 20 % is granted.
The bill for advertisements is payable in international currency by equivalent change (please contact the Editorial office for details).

Glavna i odgovorna urednica
časopisa Drvna industrija

Editor-in-Chief

Prof. Ružica Beljo Lučić, PhD

Predsjednik Izdavačkog savjeta
časopisa Drvna industrija

President of Publishing Council

Prof. Ivica Grbac, PhD

PRETPLATA NA ČASOPIS DRVNA INDUSTRIJA

za volumen 61

Želimo se pretplatiti na časopis Drvna industrija, volumen 61 i želimo primati________ primjeraka svakog broja. Cijena jednog volumena (godišta) iznosi 300,00 kn u Hrvatskoj ili 55 EURA u inozemstvu.
Obvezujemo se uplatiti iznos od ______________ kn (EURA) na žiro račun broj:

2360000-1101340148
ili
devizni račun:
2100061795
(plaćanje SWIFTOM: ZABA HR 2X2500 - 03281485)

s naznakom “Za časopis Drvna industrija, poziv na broj 3 02 03"

Tvrtka:____

Matični broj tvrtke:_____________________tel:_____________________ fax:___________________

M.P.

____
Potpis odgovorne osobe

WOOD INDUSTRY SUBSCRIPTION

We wish to subscribe for the WOOD INDUSTRY journal for Vol. 61 and wish to receive __________copies of each issue. We shall pay an amount of 55 EUR by bank draft in EUR funds or international money order by SWIFT to ZAGREBACKA BANKA d. d. - code ZABAHR2X 2500-03281485

Name____

Company/organization____

Tax number______________________________ Phone ___________________ Fax _____________

Adress (street, city)____

Postal code, region, country____

Signature____