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## The research of virtual production in wood industry

Tomislav GRLADINOVIĆ<sup>1</sup>, Leon OBLAK<sup>2</sup>, Jože KROPIVŠEK<sup>3</sup>, Tomislav PORŠINSKY<sup>4</sup>, Denis JELAČIĆ<sup>5</sup>,  
Darko MOTIK<sup>6</sup>

### Abstract

Enterprises with inflexible production structures can no longer survive in a turbulent market, as they cannot react to changes that would lead to their development. In order to satisfy specific customer needs related to quality, quantity, cost and delivery terms, it is necessary to restructure the existing enterprises according to the Taylor principle. One of reconstruction possibilities is the implementation of new co-operation forms that lead to virtual enterprises i.e. changeable networks. A changeable network can only achieve efficiency by means of a modern information and communication technology. This paper presents an idea of a changeable network that can be acceptable for all participants within a virtual enterprise.

**Key words:** wood industry, co-operation, virtual enterprise, changeable network, information

## Raziskava virtualne proizvodnje v lesni industriji

### Izveček

*Podjetja z nefleksibilno proizvodno strukturo ne morejo več preživeti na turbulentnem trgu, saj ne morejo odreagirati na spremembe, ki bi lahko vodile v njihov razvoj. Zato, da bi zadovoljila specifične potrebe potrošnikov, povezane s kakovostjo, količino, stroški in dobavnimi roki, je nujna reorganizacija obstoječih podjetij po Taylorjevem principu. Ena izmed reorganizacijskih možnosti je implementacija nove kooperacijske oblike, ki vodi do virtualnih podjetij oz. spremenljivih mrež. Učinkovitost lahko zagotovijo samo spremenljive mreže, in to s pomočjo moderne informacijske in komunikacijske tehnologije. Članek predstavlja idejo spremenljivih mrež, ki je lahko sprejemljiva za vse udeležence v virtualnih podjetjih.*

**Ključne besede:** lesna industrija, kooperacija, virtualna podjetja, spremenljive mreže, informacija

## 1 Introduction

### 1 Uvod

The managers of Slovenian and Croatian wood enterprises are trying to follow the contemporary organisation trends, although they are mainly driven on by the urgency of immediate action. This results in misunderstanding of the essential reasons for the required changes.

The resulting problems and failures of the proper strategy choice and suitable partners may often disorient the managers in their decisions on introducing the new business and organisation concepts. The enterprises that successfully reorganise and redesign their wood processing and furniture enterprises by creating quality networks of partnership relations will significantly improve their business possibilities (TIPURIĆ / KOLAKOVIĆ 2002).

The results of the research (WIENDAHL 1991, WILDEMANN 1996, BELAK / VEŽA 1997, KOENIG 1998, WILDEMANN 1998, HEDBERG 1999, GRLADINOVIĆ 2000, COLLINS 2002, KISIELNICKI 2002, GRLADINOVIĆ / FIGURIĆ / VEŽA 2002) carried out so far point at the necessary preconditions for creating virtual enterprises in Slovenian and Croatian wood industry enterprises. If they wish to follow the modern business and organisation concepts, Slovenian and Croatian enterprises should apply universal models for the transition to the virtual way of business.

The enterprises that will use the knowledge and research results in their transition to the virtual business at reorganising and transforming their activities will withstand the organisation changes faster and less painfully and will find it easier to adjust to the turbulent conditions in economy (TIPURIĆ / MARKULIN 2002).

<sup>1</sup> Izr. prof. dr. T. G., Sveučilište u Zagrebu, Šumarski fakultet, Svetošimunska 25, p. p. 422, 10002 Zagreb, Hrvaška, grladin@hrast.sumfak.hr

<sup>2</sup> Doc. dr. L. O., Biotehniška fakulteta, Oddelek za lesarstvo, Rožna dolina, C. VIII/34, 1000 Ljubljana, Slovenija, leon.oblak@bf.uni-lj.si

<sup>3</sup> Doc. dr. J. K., Biotehniška fakulteta, Oddelek za lesarstvo, Rožna dolina, C. VIII/34, 1000 Ljubljana, Slovenija, joze.kropivsek@bf.uni-lj.si

<sup>4</sup> Doc. dr. T. P., Sveučilište u Zagrebu, Šumarski fakultet, Svetošimunska 25, p. p. 422, 10002 Zagreb, Hrvaška, tomlslav.porsinsky@zg.hinet.hr

<sup>5</sup> Izr. prof. dr. D. J., Sveučilište u Zagrebu, Šumarski fakultet, Svetošimunska 25, p. p. 422, 10002 Zagreb, Hrvaška, jelacic@sumfak.hr

<sup>6</sup> Doc. dr. D. M., Sveučilište u Zagrebu, Šumarski fakultet, Svetošimunska 25, p. p. 422, 10002 Zagreb, Hrvaška, motik@sumfak.hr

## 2 Materials and methods

### 2 Materiali in metode

Strategic alliances are agreements between firms in which each commits resources to achieve a common set of objectives. A strategic alliance is a formal relationship formed between two or more parties to pursue a set of agreed upon goals or to meet a critical business need while remaining independent organizations.

Partners may provide the strategic alliance with resources such as products, distribution channels, manufacturing capability, project funding, capital equipment, knowledge, expertise, or intellectual property. The alliance is a cooperation or collaboration, which aims for a synergy where each partner hopes that the benefits from the alliance will be greater than those from individual efforts. The alliance often involves technology transfer (access to knowledge and expertise), economic specialization, shared expenses and shared risk.

A virtual organization is an organization existing as a corporate, not-for-profit, educational, or otherwise productive entity that does not have a central geographical location and exists solely through telecommunication tools. A virtual organization comprises a set of (legally) independent organizations that share resources and a skill to achieve its goal, but that is not limited to an alliance for profit enterprises. The interaction among members of the virtual organization is mainly done through computer networks.

A virtual enterprise is a temporary alliance of enterprises that come together to share skills or core competencies and resources in order to better respond to business opportunities, and whose cooperation is supported by computer networks. It is a manifestation of collaborative networks and a particular case of virtual organization.

Experimental research on strategic alliances or virtual organisations was carried out in two parts. In the first part of the research, enterprises from different industrial branches were interviewed on using strategic alliance and virtual organisation. Thirty percent of the eighty-one enterprises that returned the filled in forms expressed a higher profitability than the Slovenian and Croatian percentage. Forty percent of them showed average profitability, while 30% of the enterprises reported lower than the average values.

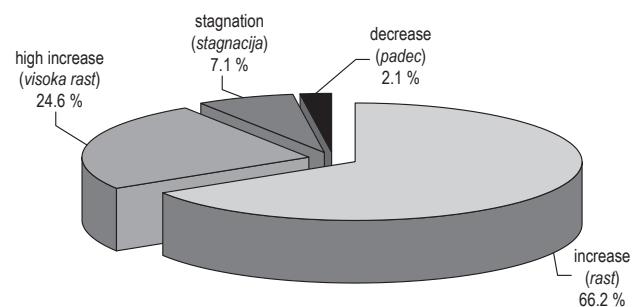
In the second part of the research, small and medium-sized wood enterprises were chosen from a sample. They were interviewed on the use of the virtual organisation concept. We received seventy-one answers. The sample and the answers are relatively indicating for the situation on the Slovenian and Croatian market.

The results were processed and statistically analysed by Microsoft Office Excel 2003 for Windows computer programme.

## 3 Results and discussion

### 3 Rezultati in razprava

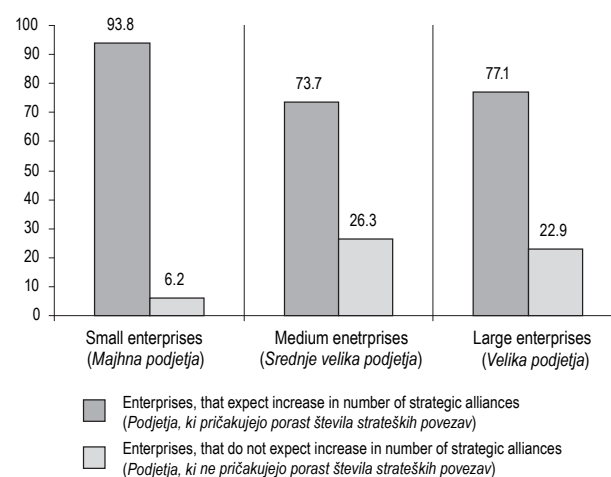
The expectations about the participation of enterprises in the strategic alliances are optimistic. Figure 1 shows the expectations of Slovenian and Croatian managers about the future business strategic alliances in Slovenia and Croatia.



**Figure 1:** Expectations of Slovenian and Croatian managers about the future business strategic alliances in Slovenia and Croatia

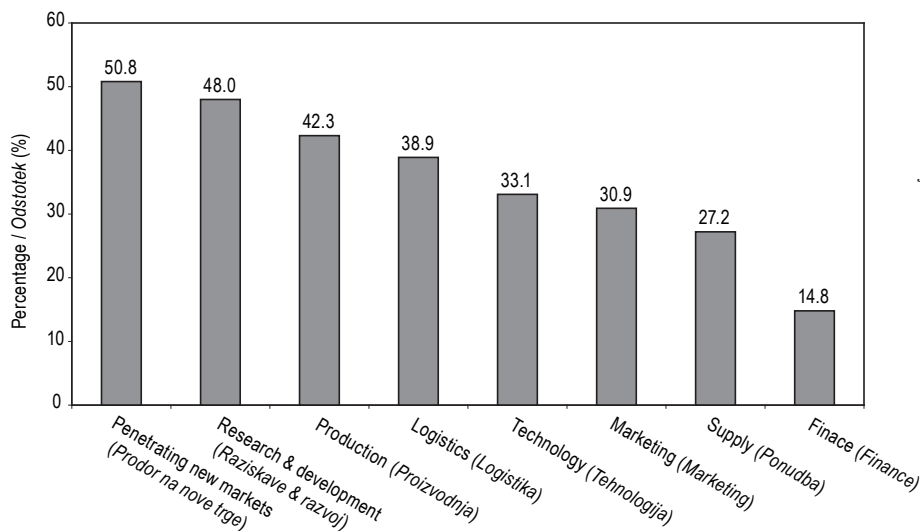
*Slika 1:* Pričakovanja slovenskih in hrvaških managerjev o prihodnjem poslovnem strateškem povezovanju v Sloveniji in na Hrvaškem

Almost two thirds (66.2%) of managers expect that enterprises will be increasingly joining strategic alliances with partners. Another percentage of them (24.6%) think that this increase will be very high. On the other hand, 7.1% of the managers think that the co-operation in the form of strategic alliances will remain at the same or similar level, while only 2.1% believe that the future will bring a decrease in such business activities. Considering the size of these enterprises, small enterprises are extremely pleased about joining strategic alliances (Figure 2).



**Figure 2:** Expectations of the managements of small, medium and large enterprises on promoting the entry into strategic alliances

*Slika 2:* Pričakovanja managementa majhnih, srednje velikih in velikih podjetij o pospešenem vstopanju v strateške povezave



**Figure 3:** Appropriate business function for participating in a strategic alliance

*Slika 3: Primerne poslovne funkcije za sodelovanje v strateških povezavah*

A major advantage of strategic alliances is the possibility of contributing to the general competitiveness of enterprises by different business functions. Within the research, the managers were interviewed on the part of business functions that are most suitable for such kind of co-operation.

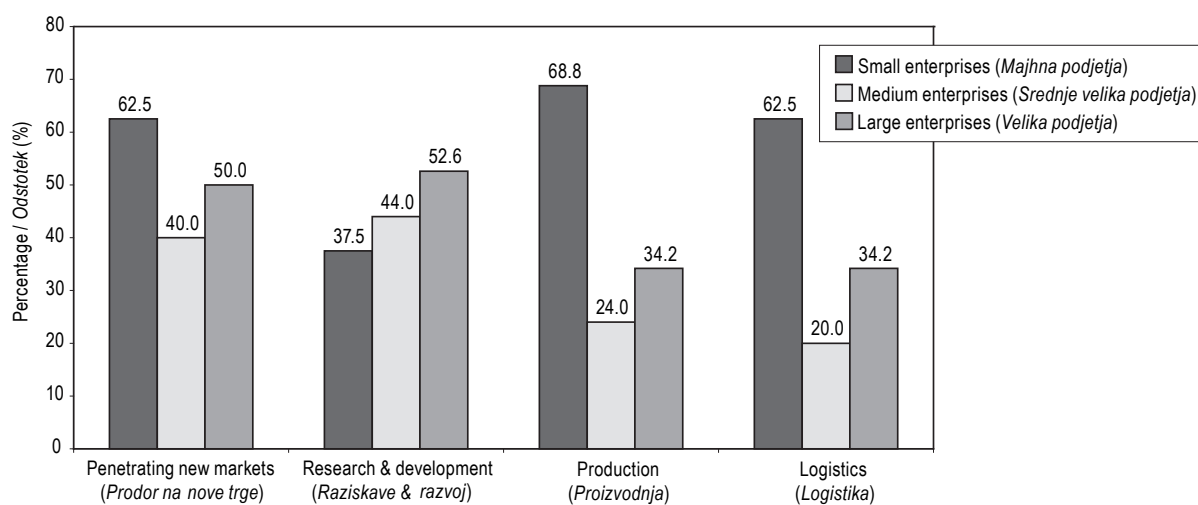
More than half of the managers (50.8%) consider the entry into new markets as a good support for organising strategic alliances. A slightly lower percentage of managers (48.0%) think that the function of research and development could be a good environment for strategic alliances. Further on, 42.3% of managers believe that production is crucial, while almost the same number of them (38.9%) regard logistics as essential. For 33.1% of the interviewed managers, technology plays the most important role and 30.9% think that marketing is the most important function,

while 27.2% of them think that supply activities are essential. Only 14.8% of the examined believe that there is a possibility of strategic alliances through financial functions of the enterprises.

Considering the analysis based on the size of the enterprise, the managers of smaller enterprises think that production is the best support for strategic alliances. Medium and large enterprises look for strategic partners mainly in the areas of research and development (Figure 4).

The results of the experimental research on the establishment of virtual organisation in small and medium wood enterprises have shown the following significant results:

- 89% of small and medium enterprises believe that the virtual organisation alliance will have better business results;



**Figure 4:** The most suitable business function for participating in a strategic alliance according to the managers of small, medium and large enterprises

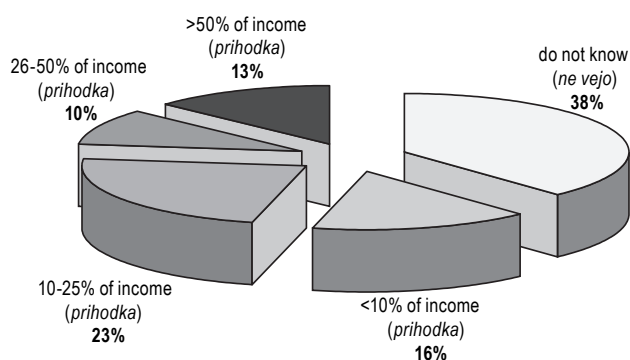
*Slika 4: Najbolj primerne poslovne funkcije za sodelovanje v strateških povezavah po mnenju managerjev majhnih, srednje velikih in velikih podjetij*

- 81% of small and medium enterprises think that virtual organisation is a better variant than the development of formal limitations of classical enterprises;
- 50% of them already use some kind of business contacts and relations with virtual organisations.

An interesting feature is the proportion of total income of small and medium enterprises achieved at different network levels. The following are the results of interviewing small and medium enterprises that use some kinds of business alliances:

- Most managers of small and medium enterprises (38%) have no data on the income percentage realised by business alliance;
- The income proportion of a business alliance within the total income of such enterprises shows that:
  - 16% of small and medium enterprises realise up to 10% of their income through such alliances;
  - 23% of small and medium enterprises realise 10%–25% of their income through such alliances;
  - 10% of small and medium enterprises realise 26%–50% of their income through such alliances;
  - As many as 13% of small and medium enterprises realise 50% or more of their income through such alliances, which is a good result.

Figure 5 shows the income percentages of small and medium wood enterprises realised by business associations.



**Figure 5:** Income percentages in small and medium wood enterprises realised through production network

*Slika 5: Odstotek prihodka, ki so ga majhna in srednje velika lesna podjetja realizirala skozi mrežno proizvodnjo*

Amongst the enterprises that use some kind of business alliances, 72% are satisfied with this type of cooperation. According to the obtained results we may establish that Slovenian and Croatian enterprises are trying

to follow modern organisation trends. However, the reason for this seems to be the inclusion of market competition, or their imitation, and the need of intervention. This shows the misunderstanding of such business models. As a result, the errors in choosing the right strategy are also reflected as the errors in choosing the right business partner. The errors in strategic changes can then discourage the managers in making decisions on organisation innovations. Those enterprises that have been successfully united forming quality partnership networks realise better business results (TIPURIĆ / KOLAKOVIĆ 2002).

We shall observe the architecture of the production network and the functioning of the leading enterprise (1999–2005). This enterprise should develop a production network that would welcome independent, adjustable and innovative units. The aim of creating strategic alliances is to increase the adjustability and capability of reacting to buyers' demands, to stimulate independency and synchronisation of small and medium wood processing enterprises and furniture manufacturers. The project of production network consists of an organisation and production structure with business and production processes based on modern organisation concepts. The leading enterprise has thus been encouraged to develop virtual network production, while a precondition for the competitiveness of the production within the work division has been realised. The leading enterprise in such a strategic structure consists of six departments: manufactured board production, sawmill with seasoning facilities, service and administration. This is accompanied by eleven small and medium-sized wood processing enterprises and furniture manufacturers. The organisation structure of the leading enterprise contains a virtual enterprise whose structure consists of the cooperating association, forming the production network and the distribution and sales centre of wood products. The leading enterprise and the cooperating partners are not separated by competition, but communicate and try to fulfil the market functionalities. The leading enterprise assigns one part of its market orders to the medium, small and trade enterprises. The cooperating partners are in this way united into the leading enterprise. In case of a reduced demand, they can easily focus on the local market changing their supply. The virtual enterprise has unlimited possibilities. Its basic aim is to increase the competitive capability on the market and to seize its larger segment.

Supported by the production network of its cooperating partners, the leading enterprise can thus achieve better adjustability to the market and the production. The cooperating partners carry out a number of services for the leading enterprise (e.g. cross-cutting, resaving and planning, shaping, turning, sand milling, drilling, joining, gluing, surface finishing, assembling, packing, storing before delivery, etc.).

The distribution sales centre whose virtual enterprise has the task to collect products from the cooperating partners

and assemble them. Its further field of work is wholesale and retail, the issue of work orders according to the buyer's desires and demands, the preparation of the technology, the building of the production network according to the work order, the establishment of the capacities, and the distribution of jobs within the network.

Modern information-communication technology is applied to the data processing and the preparation of work orders. The following are the aims of a virtual enterprise:

- higher adjustability and orientation towards the market,
- to size a larger market segment,
- to increase the capacity use,
- bigger production volume,
- better use of the products,
- higher competitiveness of the products' prices,
- to increase the profitability,
- to establish a quality-oriented management,
- to focus on the technological process,
- a production network as a priority element of forming the organisation,
- reinforcement of the firm's own responsibility,
- team work,
- application of information/communication technology,
- cooperation beyond the firm's area (buyer – supplier),
- gradual introduction of development measures.

The preconditions for proper inclusion of the virtual enterprise into the world work division and the global market contest have thus been established.

## 4 Conclusion

### 4 Zaključek

The described system of production networks enables lower product prices, seizure of a larger market segment, and higher competitiveness and profitability, enabling better control of costs, production time, quality and quantity of wood products. It also helps to reduce capital binding. Lower are also the investments into the enterprise infrastructure. The waste disposal issue is also reduced, since one part of the enterprise waste returns to the manufactured board production. Innovations and advancements of the production, work organisation, products, etc., are achieved by network change. The functions of management, coordination and controlling are established within the virtual enterprise, offering modern logistic support to the production network. Altogether, a better control of the total production costs and high quality of wood products and services are achieved. The leading enterprise has all sorts of possibilities of capital investments and new product projects, marketing, supply, trade,

transport, etc. The participation contributes to the widening of the network and operation relations (rising employment, wider product assortment, innovating processes, etc.)

Expectations of the Slovenian and Croatian managers about the future business strategic alliances in Slovenia and Croatia are very interesting. 66.2% of managers expect that enterprises will be increasingly joining strategic alliances with partners. About half of the managers consider the entrance into new markets as a good support for organising strategic alliances. They also think that the function of research and development could be a good environment for strategic alliances. A lot of small and medium enterprises think that the virtual organisation alliance will have better business results. Amongst the enterprises that use some kind of business alliances, 72% are satisfied with this type of cooperation.

Virtual enterprise has also certain disadvantages. It should have a large sales/supply market of wood products and should educate the employed cooperating staff in the fields of marketing, logistics, engineering, the "new economy", e-business, etc. Between the leading enterprise and its cooperating partners there is infrequently a sense of distrust. Cooperating partners have old cost-rising production technology. The flow of the material entails additional, undesired transport among the cooperating partners, which increases product prices. The quick changes of strategies and competition, the changes of the present technologies with the development of the new ones, and the changing buyers' requirements are the impacts upon a virtual enterprise. The buyer's influence is an essential feature of the concept. The absence of modern information and communication technology inhibits the communications among the virtual enterprise constituents. The cooperating partners bear business risks. A necessary precondition for this is a high competence for individual jobs and services. The participants are fully responsible for the terms, quality and quantity of the products and services. It is important to establish cooperation despite the competition, because cooperating partners compete among each other, e.g. by the prices of their services and job assignments, while they participate in the same production network. The lack of initial financial means for starting and developing production network is another weak point. It is explained by the long cycle of the turnover in wood processing and furniture manufacture. The economic indices have not confirmed a particularly high rise and successfulness of the virtual network production.

## 5 Summary

In order to survive in the global environment, Slovenian and Croatian wood-processing enterprises must specialise in the fields in which they can achieve best results, on the basis of which they could develop and create partnerships with complementary business partners.

However, the transformation process (virtualisation) of Slovenian and Croatian enterprises is slow and accom-

panied by a number of strategic errors that cause crises and enterprise destruction.

Wood processing enterprises must learn fast, implement the acquired knowledge, and permanently develop new ideas. They must also develop a working environment and accept changes, because a change is an opportunity for survival and faster development. The acceptance and adjustment to these requirements are indispensable at the present time.

A significant application of the virtual concept organisation at a micro-level would enable a fast and painless transformation of classical enterprises. At a macro-level, it would increase the competitiveness in wood industry.

According to the presented requirements of a general approach to the development of a virtual enterprise, we may conclude that such an approach enables a series of advantages in wood product manufacturing, although there are certain disadvantages. The forests and forestlands of Slovenia and Croatia are the basis of an intensive development of wood processing and furniture manufacture. A guideline in a leading enterprise reconstruction is the acceptance of the new cooperating and supplying relations focused upon the virtual enterprise and its production network. The chief guideline of a virtual enterprise is the possibility that a product is made at any time and everywhere, in any form and size. This means that the whole organisation of the leading enterprise should be established so that it can offer its buyers individual and immediate supply of the desired product. This is the central place in the development of organisation and production structures, and it offers unlimited possibilities on the wood product market.

## 5 Povzetek

Če želijo slovenska in hrvaška lesno-industrijska podjetja preživeti v globalnem okolju, se morajo specializirati za področja, v katerih lahko dosežejo najboljše rezultate, na katerih bodo razvijala in oblikovala partnerske odnose s komplementarnimi poslovnimi partnerji.

Proces transformacije (virtualizacije) slovenskih in hrvaških podjetij pa poteka počasi ob številnih strateških napakah, ki povzročajo krizne situacije in propade podjetij.

Lesno-industrijska podjetja se morajo hitreje učiti, uporabljati pridobljena znanja in nenehno razvijati nove ideje. Poleg tega morajo razvijati tudi delovno okolje in se sprijazniti s spremembami, saj so prav spremembe priložnost za preživetje in hitrejši razvoj. Sprejemanje in prilagoditev tem zahtevam je v današnjem času neizogibno.

Večja uporaba koncepta virtualne organizacije na mikroravni bi omogočila hitrejše in manj bolečo transformacijo klasičnih podjetij, na makroravni pa bi se tako povečala konkurenčnost celotne lesne branže.

Na osnovi rezultatov raziskave in prikazanih zahtev po splošnem pristopu k razvoju virtualnega podjetja lahko zaključimo, da tak pristop zagotavlja številne prednosti v lesni proizvodnji, ima pa tudi določene pomanjkljivosti. Slovenski in hrvaški gozdovi so osnova za intenziven razvoj predelave lesa in proizvodnje pohištva. Ena izmed smeri rekonstrukcije vodilnih podjetij je sprejem novih odnosov s kooperanti in dobavitelji, pri čemer je treba težiti k virtualnemu podjetju in njegovi proizvodni mreži. Rdeča nit virtualnega podjetja je možnost, da se proizvod lahko izdelava vedno in povsod, v vsaki obliki in velikosti. To pomeni, da se mora celotna organizacija vodilnega podjetja postaviti tako, da svojim kupcem omogoča individualno in trenutno nabavo zelenih proizvodov. To je osrednje mesto v razvoju organizacijskih in proizvodnih struktur in omogoča neomejene možnosti na trgu lesnih proizvodov.

## 6 References

### 6 Viri

- BELAK, V. / VEŽA, I., 1997. Virtualno poduzeće – prospekt za budućnost. Računovodstvo, revizija i financije 6, 7: 1241–1250.
- COLLINS, P., 2002. Virtual and networked organizations. Capstone, Oxford, 122 s.
- GRLADINOVIĆ, T., 2000. The management of changeable networks in wood processing and furniture manufacturing as a high technology support. V: Scientific Council for Agriculture and Forestry, Croatian Academy of Sciences and Arts, Zagreb, 117–128.
- GRLADINOVIĆ, T. / FIGURIĆ, M. / VEŽA, I., 2002. Razvoj proizvodnih mreža u preradbi drva i proizvodnji namještaja. Strojarstvo 44, 3–6: 145–155.
- HEDBERG, B., 1999. Virtual organizations and beyond. J. Wiley, Chichester, 237 s.
- KISIELNICKI, J., 2002. Modern organizations in virtual communities. IRM Press, Hershey, 310 s.
- KOENIG, S., 1998. Information driven management concepts and themes. K.G.Saur, München, 73 s.
- TIPURIĆ, D. / KOLAKOVIĆ, M., 2002. Competitiveness of the small and medium enterprises in Croatia: Strategic alliances and virtual organization challenges. Asian Small Business Review 5, 1: 1–20.
- TIPURIĆ, D. / MARKULIN, G., 2002. Strateški savezi, suradnjom poduzeća do konkurentske prednosti, Sinergija – Nakladništvo, Zagreb, 392 s.
- WIENDAHL, H. P., 1991. Anwendung der belastungsorientierten Fertigungssteuerung. Hanser, München, 526 s.
- WILDEMANN, H., 1996. Netzwerkstrukturen als neue Form der Unternehmen-organisation, ZWF 91, 12, 1–2: 12–16.
- WILDEMANN, H., 1998. Zulieferer: Im Netzwerk erfolgreich. Harvard Business Manager, 4, 17: 93–104.