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SWOT STRATEGIES FOR FORESTRY LOGISTICS IN SIX EUROPEAN REGIONS

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The paper presents findings from a comparative analysis of three major topical fields of interest notably supply chain management, technological progress and mass flux analysis in six European forest regions of the IN2WOOD project (FP7 RoK 2010–2012). The study identifies matching strengths and weaknesses and summarizes cross-regional priorities. Based on this information, a set of the region's strategies was compiled in view of the general objective to optimise logistics. Four different strategy types were proposed: SO-strategy (internal strengths were used to realise external opportunities, WO-strategy (reducing internal weakness to realise external opportunities), ST-strategy (internal strengths were used to minimise external threats) and WT-strategy (reducing the internal weaknesses to avoid external threats). Main common strategies for forestry logistics are: developing clear concepts for the implementation of ICT applications for difficult terrain like GPS-maps in mountainous regions, increasing the possibility of co-operations between the actors involved and developing a detailed mass flux analyses as a basis for SCM concepts.

Key words: *logistics in forestry, logistics strategies, supply chain management*

1. Introduction

Demand for wood as a renewable material is increasing worldwide. Its importance and the demand will grow in the future. Main drivers are an ever increasing world population, a higher living standard in developing countries, public support and incentives to stimulate the use of wood and the growing importance of wood in the primary energy mix. Given that more and more international and national instruments supporting environmental and nature preservation come into force, sustainable and responsible forest management calls for advancements in logistics and supply chain management.

In the classical approach of business studies and logistic, the partners of a logistic network are isolated without solid connections. For every member it is supposed that business decisions, procurement, goods and services and distribution are handled individually. This is referred to as the traditional competitor's model. The cooperation bases are often short term contracts with small batches offering the possibility to change a supplier immediately when a cheaper price is available on the market. Terms like service and quality are generally considered of minor priority. This situation leads to relative insecurity about the time period of cooperation and claims a variety of offers from various partners (Mühlberg, 2010). In the widest point of view, the supply chain not only includes the producer and its suppliers. Depending on the logistical flows it also considers processors, transporters, ware-

houses, retailers, service organizations and consumers. In the system of Supply Chain Management (SCM), a 'business process' can be seen as a structured, measured set of activities designed to produce a specified output for a particular customer or market. Next to the logistical processes in the supply chain, which include activities such as operations, inventory management and distribution, business processes are distinguished such as those associated with new product development, marketing, finance, and customer relationship management (FAO, 2007). Efficiency of supply chain management can be improved by using modern software based technologies. Modern logistics computer applications have already found their way into forestry, as for example in Scandinavian countries (Carlsson, Rönnquist, 2005). These sophisticated techniques have cost saving potential and thus increase efficiency of logistics (Troncoso, Garrido, 2005; Frisk *et al*., 2010; Sarac *et al*., 2010).

The paper presents a comparative analysis of three major topical fields of interest, identifies matching strengths and weaknesses and summarizes cross-regional R&D priorities. Based on this information, a compilation of the region's strategies was worked out. The paper aims at improving forestry and wood industry logistics in the regions by targeting three major strategic fields of logistics (Mühlberg, 2011):

- Supply chain management – a core discipline and domain of practice for the forest industries integrating the high number of small companies in the sector and aiming on the successful establishment of sustainable long term co-operations
- Technological progress (RFID, GIS) – investigations in new communication technologies, transfer of state of the art technology and the improvement of current logistics concepts have great potential as a large potential to reduce transport costs and to increase the competitiveness of regional products
- Mass flow analysis – analysis of material flow and definition of the quantities are seen as core information for future coordination and advances, especially with respect to sustainable management goals.

2. Methods and material

The present state of regional forest supply chains and strategies were assessed stepwise to build-up an overall strategy for forest logistics: status quo and trends analysis, SWOT analysis, and regional strategies development. First, the situation in the six regions was analysed using a commonly used strategic method – the SWOT analysis according to technique by Rauch (2007), based on the status quo and taking into account major dominant trends (economic, political, social, ecological, and climatic). SWOT analysis is an instrument of strategic management of companies or products. Internal strengths and weaknesses as well as external influences, which can be opportunities or threats are analysed in order to derive promising future strategies. Strengths, weaknesses, opportunities and threats, are first specified for the object under investigation and then the items per topic are ranked. SWOT analyses are useful for scanning internal strengths and weaknesses of organisations as well as for illuminating the opportunities and risks of a dynamic environment (Rauch, 2007).

Status quo and trends analysis produced necessary background profiles per each region. The internal and external factors which were most important to the enterprise's future were referred to as strategic factors and were summarized within the SWOT analysis. In the next step, strategies for each region were formulated taking into account status quo and responding to the extracted trends and pilot ideas. The final goal of the strategic planning process, of which SWOT is an early stage, is to develop and adopt a strategy resulting in a good fit between internal and external factors (Kurtilla *et al.*, 2000). Good strategy maximises strengths and opportunities and minimises threats and weaknesses (Kohlöffel, 2000). For mapping out the strategies, the SWOT table has to be searched for logical SWOT combinations, which answer the following questions (Lobriser, Abplanalp, 1998; in Rauch, 2007):

1) Which strength fits with which opportunity (SO-combination)?
2) Which strength fits with which threat (ST-combination)?
3) Which weakness fits opportunity (WO-combination)?
4) Which weakness fits with which threats (WT-combination)?

The formulation of strategies started with finding the combinations, whereby four different strategy types can be considered (Rauch, 2007):

1) SO-strategies: internal strengths can be used to realise external opportunities (ideal case).
2) WO-strategies: reduce internal weakness or develop missing strength to realise external opportunities.
3) ST-strategies: internal strengths are used to minimise external threats.
4) WT-strategies: reduce the internal weaknesses to avoid external threats (defensive strategy, worst case scenario).

In the last step, the region's strategies were compared and connected to each other, discussed and common embracing strategies were formulated, which relate to two or more regions. The common strategies were analysed and pointed to similar aims.

3. Results

3.1. Regional profile and SWOT analysis of North Rhine Westphalia (NRW), Germany

The strength of the forestry and the wood working industry of NRW is its immediate vicinity to the large consumer markets in Europe, together with the availabi-

lity of a well established road infrastructure. Forests of all types of ownership are well developed and have had a sufficient network of forest paths since the end of the 1970-ies. The pathway density in dependency on the terrain is 50–100 running m/ha. In inaccessible scarp locations with a high pathway density, generally rope draggers are used for bringing the wood in; the utilisation of rope cranes is rather an exception. Forest technology is mainly utilised by contractors and service providers and features the latest state of the art, utilising the most modern and best adjusted systems for timber harvesting. The same applies for the vehicles of the trucking companies. The potential of on-board computers are currently not being utilised in the area of timber harvesting logistics. At this time, the logistics in NRW depends mainly on the co-operation of small independent enterprises (logging companies, movers, transporters). It is secured predominantly by telephone communication, fax and email between the currently active partners. When organising the logistics, the companies rely on their knowledge of the locations.

Currently, the following sales procedures are being utilised within the frame of logistics:

- Timber sale 'Free Forest Road' – forest owner organises the harvest and the transport up to the forest road, the timber industry organises any further transportation;
- Timber sale by own advertising – the advertiser organises the entire chain "from the stick to the mill" (which are usually forestry service providers).

The timber industry, which depends on "deliveries just in time", regulates its logistical processes internally; hence, the forest owner can hardly influence these procedures. On the other hand, the timber industry can exercise only a limited scope of influence on the timber harvest in the forests. The most significant precondition, however, is the readiness of all partners participating in the logistics process "from the tree trunk to the mill" to co-operate constructively. Within regional forestry business co-operations, forest owner associations, timber companies, transport companies and consumers, need to jointly develop and implement more complete delivery chains, i.e. bundling of cutting volumes, tendering of cutting works, rational transport, synergies in route planning, reduction of empty runs. At the same time, innovative information technology, corresponding applications and compatible systems should be utilized and implemented.

Strengths	*Weaknesses*
• Good forest road infrastructure • Research institutions located in NRW • Competitive producers of components and software for timber logistics	• No holistic concept available for cooperation between forest owners, transportation companies and wood industry

Strengths	*Weaknesses*
• Powerful entrepreneurs in wood logistics • Successful tests with GPS-supported wood positioning of forest machinery	
Opportunities	***Threats***
• Improved co-operation between enterprises and research institutions • Development of IT tools for a holistic logistical chain concept • Project „Virtual Forest": complex information platform for forest inventory, navigation, logistics and forest economy	• Increasing costs (taxes, fuel, etc.) for transportation companies in NRW • Applicable, real-world solutions for logistical systems need to be available promptly and cost-efficient • Lack of coordination among specific platforms in different federal states

3.2. Regional profile and SWOT analysis of Styria, Austria

In Styria transport costs amount to 15% – 30% of the total round wood price. Drivers for transport costs comprise a number of factors like terrain, forest road network, forest owner structure, structure of the wood working industries, harvest technology, and round wood market conditions. The majority of felling operations must be carried out manually with chain saws and hauled by means of tractor and wrench or by cable crane which incurs higher harvesting and transportation costs. Due to the high elevation of the area, logging activities are additionally hampered by very cold and snowy winters.

Styria has one of the tightest forest road networks in Austria with 55 m/ha in average. The majority of the forest roads are paved with gravel or broken stone (approx. 70%). Additionally, Styria has approx. 34 500 km of skid trails (National Forest Inventory, 1996). In areas with steep slopes the density forest roads is higher due to the use of less mechanized harvesting techniques. In Styria, private forest ownership amounts to approx. 90% of the forest area. About 2/3 of the private owned forest is considered as small-scale forest property with less than 200 ha. Nowadays 13 regional forest associations in total exist, covering all Styrian districts. In Styria, the high degree of organization among forest owners is considered as a precondition for an efficient logistic chain as the information and communication flow happens with least effort between forest owner associations and the wood working companies. The forest owner associations organize the procurement of round wood for their customers in the right quantity, high quality and at the right time.

The structure of the Styrian wood working sector shows no distinct gap apart from the absence of manufacturers of particle or fibre boards. The total production value of the Styrian forest industries amounts to

4 billion EUR, with the pulp- and paper industry contributing 47%, followed by the wood working industry with 19% and carpenters with 10%. The nine largest sawmills in Styria consume 2.5 mio. m³ round wood annually, with the largest one – Mayr-Melnhof, Leoben-Göss, attributes to 1.25 mio. m³ round wood (Holzkurier, 2008).

About 80% of the round wood is sold "free forest road". Over the last years, an increase in sales "on stump" and in "free delivery to firm gate" has been observed. The reason for "on stump" is that forest owner associations and other round wood traders offer sales "on stump" as a service to forest owners that have moved into towns and are not anymore capable of performing or even organizing logging operations by themselves (Pretterhofer, personal communication, September 2, 2010). In Styria approx. 1600 transport companies with a fleet of 10 600 trucks are registered. The equipment of the trucks is up to date as road pricing in Austria is based on the emission class of the truck. Approx. 80 transport companies are dealing with round wood transport services. The primary wood processors are usually responsible for the organization of the timber transport "off the forest road" to the factory. Currently, the biggest challenge is the information flow between forest owners, transport companies and wood processors. Interestingly, beside technological barriers like missing technical equipment, or being not familiar with the gadget required, psychological barriers play an important role. These barriers comprise loss of autonomy, loss of (market) power due to transparent transactions, and mistrust against possibly unknown transport companies entering the own forest. Another important issue is the lack of digital data about the forest road network and the forest road attributes.

Strengths	*Weaknesses*
• Well established partnership between actors in the whole supply chain • High competence in the field of logistics • Availability of IT tools for logistics • Well established structures (associations) in the forest & wood working sector • Excellent road, railway and forest road infrastructures • Data exchange standards exist between log suppliers (forest owners) and the sawmilling industry	• No data exchange standard between the saw milling industry and the secondary wood processing industry • No overall supply chain management (SCM) • Little to no use of GIS data in the supply chain • No regional concept for emergency storages in case of calamities (like wind breaks) • Continuous trend to shift transport volume from railway to road transport

Opportunities	*Threats*
• SCM for the whole supply chain • Usage of modern ICTs like RFID, GIS applications • Gapless digital information flow from sources (forestry) to sinks (wood processing units), implementation of an electronic invoice system • Establishment of local wood terminals (hubs for round wood, sawn wood and biomass) and a regional logistics centre for the forest-based industries	• Lack of capital to invest in necessary equipment • Failure to introduce logistics solution in the sector will lead to a competitive disadvantage of wood working industry • Competition instead of cooperation between companies in the supply chain • Companies are not willing to review the profitability of their business processes and to consider outsourcing some of their minor businesses

3.3. Regional profile and SWOT analysis of South Tyrol, Italy

South Tyrol's location in the middle of the Alps and its elevation profile leads to high logistic efforts when it comes down to the wood industry and the exploitation of the forest. Difficult to reach areas, small private properties and unfavourable relation between work and economic value avoid extensive projects. In order to guarantee an economic use of the natural resources, South Tyrol has invested in a high density forest road network over the past years. Currently the density of goods traffic and forest roads is about 42 m/ha. Furthermore the exploitation makes important activities possible to secure the natural protective function of the forest. In 1989 the first recordings of streets and roads were made. Under the leadership of the regional department for forest planning, all municipal streets, highways, state roads and railroads were recorded including hiking, alp and forest trails. The percentage of opening regarding the primary transportation in the forest area is divided into 3 categories. Until 100 m primary transportation distance 43% are economically developed, until 400 m 85% and till 800 m 91% are economically developed. Several maps are available in very detailed form (forest type map 1:25.000; digital road net 1:10.000; protection forest note card 1:25.000; forest fires service map and forest fire event map; forest ownership structure map 1:25.000; treatment plans for forest and pasture land 1:10.000).

Though the information about the logistics in forestry is very good documented, the track gets lost in the further steps. The mass flux from forest through the other branches like transport companies, sawmills and other wood processing enterprises is not recorded in any statistics. Furthermore new technologies shall be found and implemented for a web based information system using global information system (GIS) and global positioning system (GPS) data.

Strengths	*Weaknesses*
• High density of forest roads, high grade of accessibility even in remote locations • All roads are GPS tracked and the information is available to public through *Geobrowser24* • Small sawmills operating locally, good knowledge of road system	• Missing of a defined Supply Chain Management for the wood industry • Little information of mass flux for the wood sector • Very little cost analysis and no time registration: difficult cost calculation • Unsatisfying data exchange between enterprises and authorities • No professional software support, mainly MS office products are used • Mountainous area includes high transportation costs
Opportunities	*Threats*
• Creation of central information unit which is accessible through the internet • Implementation of new technologies i.e. wood pile management, GIS • Develop common strategies for small forest owners • Good opportunities for new technologies for optimisation of wood flow	• Increasing costs will threaten development • Competition instead of co-operation --> fear of loosing market power

3.4. Regional profile and SWOT analysis of Grisons, Switzerland

Grison as a mountainous canton has a very difficult topographical disadvantage regarding the guarantee of efficient and cost effective logistics in the wood chain. Among other things, primarily the poor navigability and development of the mountain forests should be mentioned. In Grisons there is mostly a long and costly pre-transport with an easy method of transport (tractor and trailer), from the place where the timber is cut to a road that can be navigated by a lorry. The wood is reloaded several times until it is finally loaded onto the heavy goods vehicle or the train wagon. In Grisons the network of paths around the forest which can be navigated by lorry measures around 2 100 km. This corresponds to a forest path which can be navigated by lorry with a density of 11.6 running m/hectares. There are also around 2 900 km of mostly older, very narrow and steep forest paths which can not be navigated. In international comparison Switzerland has the highest transport costs by far. Additional costs of up to 4 Fr/m^3 arise due to the vehicle fee. Additional costs arise in Grisons due to the pre-transport. The forestry technology used in the company is state of the art. The foresters are very well equipped and modern and adapted wood harvesting systems are used. The same applies to the forester's fleet.

In Grisons the forestry companies also act as "wood bundlers" in many cases. There are also three independent bundling organisations, which are in construction and only take on wood marketing tasks. The whole logistic in Grisons consists of the co-operation between the forestry service, the entrepreneur and the buyers. Communication takes place by telephone, fax and e-mail. The local knowledge of everyone involved becomes very important. For this reason GPS solutions are avoided as far as possible in the logistics. The majority of the wood in the canton of Grisons is still sold by the foresters themselves even today.

In Grisons there is currently a deficit of modern IT solutions use for controlling and optimising the whole wood acquisition process from forest to forester and freighter right up to the saw mills. Modern information and communication technology helps to save time and money in the wood production chain and therefore improve the profitability in the forestry sector. Only the bundling organisations use IT solutions to a limited extent.

Strengths	*Weaknesses*
• Felling entrepreneurs are also well-equipped carriers • State forest service supports road construction • Connection to the European/ global market	• No supply chain management • In the mountain area a pre-transport to a 40 ton road is usually needed • Very high transportation costs • Railway transport: permanent closure of loading locations • No data exchange standards or IT-Tools for Logistics between forest and sawmills
Opportunities	*Threats*
• Supply Chain Management • New technologies: IT Tools, GIS applications, wood pile management etc • Data collection and exchange • Improved logistic concepts: logistics terminal for timber	• No will to cooperate in the supply chain • Financing of new technologies: IT-Tools etc.

3.5. Regional profile and SWOT analysis of Banskobystricky region, Slovakia

Until 1990, the state managed all forests, owned wood-processing and transport companies and central planed the wood flow from producers to consumers. More than 70% of timber and timber products was transported by rail network. After 1990 due to the restitution and privatization, the forestry sector, wood-processing and transport companies were fragmented with increasing of the number of forest land owners, creation of small and medium-sized wood-processing companies and related decentralization of production activities. Nowadays 463 000 ha of forests in Banskobystricky region are managed by 1 342 forest owners. Due to these facts, more than 85% of the wood and wood products

are being transported by roads and have influenced logistics in Banskobystricky region in a serious way. The density of forest road network in the Banskobystricky region is from 13 to 23 meters per hectare and it is little bit above the Slovak average (10.6 to 18.5 m/ha). Mainly in mountain areas of the region is the density of forest road network unsatisfactory, makes worsen the wood accessibility and increases production costs. Insufficient density and poor quality of forest road network lead to growing distances for timber skidding from the felling place to the hauling place. For these reasons the stem method of felling and tractor skidding of timber to the hauling place are prevailing (Moravčík *et al*., 2008; Moravčík, Novotný, Toma *et al*., 2007). A large part of machinery and technological equipment in forestry is physically old and outdated.

The wood processing industry is a dominant actor, processing approximately 65% of produced wood. Annual timber export amounted 35% of timber supplies. Wood processing, paper and pulp industry generates 14% of the total production in Banskobystricky region. Main problem in this area is lacking processor of the most valuable grades for veneer and hardwood with higher added value. There is lack of cooperation and information exchange between forestry sector and wood processors, insufficient cooperation between enterprises of wood-processing industry. Larger wood-processing and transport companies use the modern equipment for the organization and managing of logistics. Smaller companies and individual carriers do not use of GIS to optimize transport and are often using direct communication. Mass flux analyses are not done at regional level. There are data available regarding the mass flow, but data on wood products flow is missing.

Strengths	***Weaknesses***
• Geographical location of the region • Sufficient transmission capacities • The well-established network of public roads and railways • High share of forests certified by PEFC and FSC scheme, • Enough of information on wood resources and its quality.	• A large part of machinery and technological equipment is obsolete • Insufficient density of forest roads • Lack of cooperation and information exchange • Economic instability of the wood-processing industry • Lack of use of GIS to optimize transport
Opportunities	***Threats***
• Possibilities of funding from Rural Development Programme 2007-2013 • Improving cooperation between the forestry sector and wood processors, • Using the modern information technologies,	• Lack of financial resources for investments into logistics, • A large share of calamity felling resulting in the irregular supply of timber • Ongoing economic instability of the wood-processing industry.

3.6. Regional profile and SWOT analysis of Carpathia, Ukraine

For the last decade, forests of the Carpathian region of Ukraine have been underexploited by 20–30%. The main reason for this under exploitation is insufficient financing, lack of harvesting equipment and low forest road density. Today wood is harvested mostly along the roads or at ease of access to low-cost felling sites. They are skidded to the road by either horses or wheel or caterpillar tractors, which are worn out and outdated, and comparing to modern ones, they are 2–3 times less productive.

Total road length is 74.400 km. More than half of forest road have less than normative road bed width. Almost 40% of roads are in unsatisfactory status and need repair. Forest road network in the mountainous areas of the Carpathians is 3.5 m/ha, which is 5–8 times less than in other neighbouring countries (in Slovakia: 17 m/ha, in Austria: 55 m/ha). According to expert estimation, there are nearly 40 million cubic meters of wood which are technologically not accessible because of lack of roads. As a result of the socio-economic turmoil during the early phases of Ukrainian independence and the transition economy (1992–2006), there was little or no financial support from the federal budget for forest road construction and maintenance. Individual forestry enterprises invested their funds in operations that generated short-term returns, such as harvesting commercial stands, but very little was invested in infrastructure development, timber stand improvement, or long-term forest management planning.

In the Carpathian region of Ukraine there are clear preconditions for the creation of the forest cluster (available resources, all market players, market and processing capacities) (Kiyko *et al*., 2009). The forest and wood based sector of the Carpathians occupies the 4th place in the economy. The forest and wood based industries employ 52 thousand employees at more than 2000 enterprises. All these factors demonstrate socio-economic significance of this sector in the regional economy. There are no statistic data available regarding the mass flow. There are few developments going on that might contribute to the supply chain optimization. Recently the Government made a decision to introduce the electronic timber inventory and recording. The current timber record system is too cumbersome, information is submitted manually. Forestry represents a traditional manufacturing industry whether each stage of production is unconnected. Information exchange within the forest and wood based industry players is sporadic. There is a need in wider application of GIS for forest resource inventory. Creation of the online timber stock exchange is regarded as a viable solution to equal access of all stakeholders to raw resource and market price formation.

Strengths	*Weaknesses*
• Strategic location close to European markets • State forest committee supports forest road construction, though not enough. • Cluster initiatives emerging in some regions in wood-based branches	• Terrain conditions require expensive low impact harvesting equipment & roads • Low interaction between various forest owners in the sector • Little data on costs covering the whole operations of supply chain
Opportunities	*Threats*
• Concepts of sustainable forest management • Growing demand for GIS • Develop network of trade and professional associations, clusters	• Periodic floods destroy infrastructure • Not stable character of forestry programmes financing • No domestic production of forestry equipment

3.7. Common strategies of IN2WOOD regions

The current globalization is constantly pushing to reduce costs and increase efficiency of all production activities. The same equally applies to the forestry as well as the wood processing industry. Logistics of supply chain management and its optimisation is of increasing importance in the forest-based sector. Many planning problems arise along the wood chain and these cover different time horizons. Therefore a good strategy of logistics is a key to future competitiveness (Carlsson, Rönnquist, 2005).

Common Strengths	*Common Weaknesses*
• S1 Although there are differences between the partners, forests are mainly well accessible through forest roads	• W1 There is no data exchange standard between the players of the wood working industry
Common Strengths	*Common Weaknesses*
• S2 Availability of renowned research and educational institutions • S3 Advanced technical know how of the central EU regions, forest roads have been successfully GPS-recorded and implemented in suitable software • S4 All project partners are well connected to the European main markets • S5 Styria as a best practice example of a well-established forest association coordinating successfully the forest-to-mill supply chain • O1 Improvement of co-operations between enterprises, research and public institutions	• W2 No supply chain management integrated in the process chain • W3 Little to no data on transport costs for the whole supply chain • W4 Trend to move transports of wood materials from railway to road; including permanent closure of loading locations

Common Opportunities	*Common Threats*
• O2 Development of regional strategies to implement a successful Supply chain management including logistic concepts for calamities • O3 Development of concepts for the implementation of GPS-map-based programs for the logistic chain • O4 Preparation of (detailed) mass flux analyses to visualize potential regional needs • O5 Sensibilization of SMEs for accounting and cost calculations. Often they do not have an assessment of cost drivers and their impact on the overall profitability	• T1 Decrease of forest management activities due to too low profit margins e.g. utilization of low grade timber, log hauling in difficult terrain, effecting the resilience of forest stands negatively • T2 Competition instead of co-operations, fear of losing market power, and economic instability. • T3 Failure to introduce logistics solution in the sector will lead to a competitive disadvantage of the whole wood working industry • T4 Knowledge of specific regional logistic information is in the hand of some drivers. If they are not available any more, implementation of new technologies will be hindered

The **SO-strategy** reflects internal strengths of the region and uses external opportunities. It means that all current advantages will be used to realize improvement of co-operation, development of strategies and technological modernization.

1. (S2, S3 → O1, O2) In all regions there are R&D and educational institutions which are experienced in the development of regionally adapted SCM concepts. In order to utilize the whole assortment of lumber grades, a cross-regional pooling of experts, potential interested partners and stakeholders is required.
2. (S1, S3 → O3) It is needed to develop clear concepts and approaches for the implementation of ICT applications for difficult terrain like GPS-maps in mountainous regions.

ST-strategy is oriented towards strengthening internal strengths which are used to minimize external threats. Considering the current situation under global financial and economic crisis on the one hand and globalization on the other, there are pessimistic assumptions about possibilities to realize this strategy.

1. (W1→O1) It should be increased the possibility of co-operations between the various actors by implementing cross-regional data exchange standards. This will provide comparable data sets allowing cross-regional analyses
2. (W3→O4) It should be developed a detailed mass flux analyses as a basis for SCM concepts. It is important to know the material flows in order to follow up the lost value added and to identify strong/weak developments in the region
3. (W4→O1) All players of the process chain need to pull in the same direction. Saying that transport needs to be shifted from road to railway but acting the

other way is creating peradventure in the industry. A strong network must be established for the wood working industry to support positive developments and the development of the branch of industry.

4. (W3→O5) It's needed to sensibilize small and micro companies for the needs of organization in the meaning of internal cost calculation and possibilities to outsource specific services. Additionally, it is needed to quantify different logistic models as a source of future improvements.

WO-strategy overcomes internal weaknesses to pursue external opportunities. The main idea of this strategy is to strengthen the competitiveness of forestry. Preconditions and opportunities of the strategy implementation are more or less favourable.

1. (S2→T2) Most SMEs are family owned, some since generations. Their understanding of the market and of its development is often restricted to their environment. R&D and educational institutions together with other stakeholders like cluster organizations or forest owner associations, need to constantly inform SMEs about the advantages and possibilities of co-operations, taking them the fear of an uncertain future. This will increase their market power and support economic stability on firm level.
2. (S2→T3) The well-established clusters, organizations and R&D and educational institutions are the basis for competent and successful introduction of developed programs. These organizations need to be further connected by building up sustainable networks

The **WT-strategy** establishes a defensive plan to minimize internal weaknesses and to avoid external threats. Future efforts to introduce logistic solutions and effective wood flow chain management need preparation. We can conclude that is the worst case scenario.

1. (W2→T3) Future efforts to introduce logistic solutions or a supply chain management need preparation. We need to take into consideration that failure will lead to a competitive disadvantage of the whole wood working industry. The forest sector needs to be well prepared and always focused on the industry's needs.

4. Discussion and conclusions

In the view of the overall trends, the importance of wood and the related demand will considerably grow in future, particularly because of the increasing world population and living standards, governmental support and incentives to stimulate use of wood for energy and due to other socio-economic and political factors. The trends for logistics development are in close relation with the changing economic structure of the forest based sector, investments in wood production, technological innovations, and international and national forest policy priorities. Demand for wood products is one of the main drivers of investment in forest management. For these reasons, under respecting the ecological and economic principles of sustainable forest management, the importance of the supply chain management will increase. The ongoing globalization is constantly pushing to reduce costs and increase efficiency of all production activities. The same is equally true for the forest sector. Efficiency of supply chain management can be improved by providing modern software technologies. Modern logistics computer applications have already found their way into forestry.

Supply Chain Management and logistics are strongly connected to each other and are used almost in the same context. Both include a steady material and data flow alongside the process chain with the goal of increasing the end-consumers benefit and reducing the shipping charges. Like any other industries, the process chain of the wood industry is divided into micro-, small-, medium-, and big-sized companies. Medium and big enterprises are better organized because their focus is on bigger production figures than small enterprises. This need for organizational planning includes security for material procurement and foresight in production. On the other hand micro- and small-sized enterprises neither do have the necessary knowledge and time, nor are they aware of the consequences of an efficient supply chain management.

The beginning of the wood working industry is the forest. Due to the situation of small scale forest properties a high number of geographically scattered small log piles need to be integrated in the forest supply chain management. This is where forest owner associations provide a solution. Within such an organizational structure small scale forest properties can be bundled and managed together, for example regarding the accessibility of the forest and the joint marketing of significant log volumes. Also in areas where road building and harvesting operations are difficult like in the alpine regions, forest owner associations are advantageous. It is not economically feasible to install ropeways and cable cranes in an area of 5 ha; therefore properties need to be bundled.

An electronic timber inventory could be implemented which will allow to strengthen the control on illegal logging. Electronic marking and identification make the timber supply chain more efficient up to the mill. Radiofrequency marking could be used to reliably identify individual logs and correlate data relevant to the wood processing industry, e.g. quantity, quality and owner data. Mobile terminals could transmit the data to central databases and internal systems where it would be immediately available to others involved in the process. The current timber record system in the regions of Carpathia and Banská Bystrica is too cumbersome, information is submitted manually. Although, the existing RFID technology is currently economically justified only for high quality lumber, it can provide a long-term solution using the advantage of being able to read several tracked units remotely and simultaneously.

It will ensure full documentation available throughout the supply chain, and lead to quality control at every step of the process. The ability to read and write qualitative data (species, volume, and grade) on the product will give the possibility to improve working conditions for each operator (from the buyer in the forest to the receiver in the factory). Technological barriers must be broken by information campaigns and simplifying instruments.

Mass flow analyses are potential instruments for decision makers, industries, clusters, associations, and any other institution or enterprise interested in the development of a region or sector and should be conducted in regular intervals. Apart from the analyses costs, a major problem is that many companies do not see the need of such analysis and just are not interested in providing any reliable information.

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Súhrn

Dopyt po drevnej hmote ako obnoviteľnej surovine celosvetovo rastie. Na základe vývojových trendov možno konštatovať, že jej význam ako aj dopyt bude rásť aj v budúcnosti, najmä kvôli zvyšovaniu svetovej populácie, zvyšovania životnej úrovne značnej časti obyvateľstva, podpore využívania dreva na energetické účely a ďalším faktorom. Z týchto dôvodov pri rešpektovaní ekologických a ekonomických zásad trvalo udržateľného lesného hospodárstva bude rásť význam manažmentu celého výrobno-dodávateľského reťazca. Tento reťazec začína ťažbou dreva, pokračuje jeho približovaním, sortimentáciou, dopravou k spracovateľovi, premenou na produkty a končí u spotrebiteľa.

Príspevok prezentuje výsledky komparatívnej analýzy troch hlavných oblastí logistiky: dodávateľský reťazec, technologický progres a manažment materiálových tokov, realizovanej v šiestich európskych regiónoch v rámci projektu 7. rámcového programu IN2WOOD (FP7 RoK 2010 – 2012). Štúdia identifikuje silné a slabé stránky jednotlivých regiónov a na ich základe sumarizuje regionálne priority.

Na základe výsledkov jednotlivých analýz bol navrhnutý súbor regionálnych stratégií za účelom optimalizácie logistiky. Boli navrhnuté štyri rozličné stratégie:

– SO-stratégia – vnútorné silné stránky sa použili za účelom využitia externých príležitosti
– WO-stratégia – redukovanie vnútorných slabých stránok za účelom využitia externých príležitosti
– ST-stratégia – interné silné stránky sa použili k minimalizácii externých ohrození
– WT-stratégia – redukovanie vnútorných slabých stránok za účelom vyhnutia sa externým ohrozeniam.

Súčasná globalizácia neustále tlačí na znižovanie nákladov a zvyšovanie efektívnosti všetkých výrobných činností. To isté platí aj pre lesné hospodárstvo a drevospracujúci priemysel. Efektívnosť dodávateľsko-odberateľského reťazca sa môže zvýšiť používaním moderných IT technológií. Moderné PC aplikácie v oblasti logistiky našli svoje uplatnenie v lesnom hospodárstve. Ako príklad možno spomenúť škandinávske krajiny. Tieto sofistikované technológie majú potenciál znižovať náklady a tak prispieť k efektívnosti logistiky. Ďalšie spoločné stratégie v oblasti logistiky LH v uvedených regiónoch sú: rozvoj jasných koncepcií pre implementáciu IT aplikácií pre komplikované terény ako sú GPS-mapy v horských regiónoch, zvýšenie možností kooperácií medzi jednotlivými účastníkmi procesu logistiky a rozvoj detailných analýz materiálových tokov ako základu pre koncepcie v oblasti materiálových tokov.