ACCOUNTING KNOWLEDGE IN FORESTRY'S DECISION SUPPORT SYSTEMS. LITERATURE REVIEW.

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Abstract:
Accounting information, processed through modern type of decision support systems, in appropriate economic analysis framework, using previous experience, gives extra knowledge to forestry managers. In our paper, we conducted a literature review, in the field of decision support systems used in international forestry, but also about the Romanian prospects and achievements in this area. Our results are useful to researchers and developers of decision support intelligent solutions, to forestry accounting researchers and forestry managers in order to be aware of new discoveries in the field, to managerial accounting researchers interested in using economic models for decision support tools development. Our study reveals that these systems were, at first, designed to solve relatively simple management problems. Nowadays, modern systems have to cope with increasingly more challenges of adaptive management and sustainability requirements. To achieve optimal results such systems must be designed like integrative solutions and need to include accounting information and accounting knowledge. The efforts of Romanian practitioners and researchers to improve internally used decision making solution, and to improve the forestry management are notable. However, in the Romanian computer-based decision support solutions framework, account information is not synthesized, it is not complete and does not store a stock of knowledge to provide assistance to the manager at any time.

Keywords: forestry accounting systems, managerial accounting, forestry decision support, decision support systems, knowledge-based systems, accounting knowledge

JEL Classification: D6, D8, M15, M41, Q23

1. INTRODUCTION

Forestry practice involves management of complex systems at various spatial scales, from the lower site level, to the national forest. The activity is based on a set of information and knowledge with a very broad spectrum and has a strong impact on social and economic development.

More so, in forestry, we can speak about complex economic processes and the need to assist decision with a reservoir of knowledge available at the proper time. Regarding this, an appropriate solution that will support forest management act, is offered by intelligent computer systems that can provide alternative economic decision.

2. FORESTRY MANAGEMENT AND ACCOUNTING. OVERVIEW.

Forestry practice requires constant correlation between forest management in the biodiversity conservation spirit and directing towards economic efficiency. Purely economic management is unacceptable because it would decimate the trees with diameters in the ranges surrounding timber and construction assortment size. Moreover, the opportunity cost for management of biodiversity only, is too high. (Buongiorno and Gilles, 2003) [6]

Experts consider that, regarding the allocation of resources in forestry, economics are important milestones in the decision process, (Lubello, 2008; Davies and Richards, 1999) [22], [9], even when environmental management objectives are a priority, such as developing a forest conservation program case. This context also imperatively involves to compare costs or alternatives that may be followed. (Lubello, 2008) [22]

There are researchers who believe that the image currently reflected in the accounts in forestry, about forest entities environment, processes and results is incomplete and even distorted in some subdomains. (Kazana and Kazaklis, 2008; Jöbtl, 2008) [19], [17] There are proposals to extend the image both for internal needs of the forestry sector and in order to help users of information from this sector. (Jöbtl, 2008; Turland, 2007)[17], [37]

A large number of researchers (Turland, 2007; Rauscher et al., 2007; Willows et al, 2003; Pearce, et al., 2002) [37], [30], [39], [27], emphasizes in their studies that, in forestry, planning must take into account: uncertainty and atypical natural phenomena that has always been specific in the sector, risk factors (including economic ones) and force majeure events that may occur accidentally.

In Turland view, the economic major risk factors are:

3. financial risk caused by changes in the cost, caused by labor costs or pest control chemicals costs, for example;
4. financial risk caused by selling price evolution;
5. economic risk on the scale of taxes, on interest or exchange rate variation;
6. regulatory risk on products trade which may occur, for example, in the forest certification process. (Turland, 2007)[37]

When a particular domain knowledge is used to solve difficult problems that appear in practice, to explore existing opportunities and to make decisions that enhance the performance, then such knowledge is creating economic value. (Rauscher et al., 2007) [30] In terms of knowledge of forest accounts incorporated into appropriate computer systems, it can successfully assist decision under uncertainty, reducing the risks associated with certain economic or financial alternatives, leading default management process optimization.

Unfortunately, according to some studies (Eom and Kim, 2005; Ellis et al., 2004; Mowrer et al., 1997) [14], [13], [26] financial and accounting knowledge integration in decision support systems relevant in scientific literature, including forestry literature, equally as development of such systems for accounting, are accomplished at alarming low rates.

According to Eom and Kim survey, of the 154 DSS (Decision Support Systems) applications of operational management, described in the literature of scientific interest, only 6.49% of systems are designed for financial sector, while accounting systems are not at all represented. Moreover, the work team of researchers led by Mowrer concluded that of the 24 ecosystem management systems analyzed, only 15, ie 62.5%, integrates economic analysis possibilities, and, in the four of them (16.7% of total) this feature is made explicit.

- **MODERN DSS IN FORESTRY**

Decision support systems are particularly important, as they have the ability to add and select from the multitude of variables, information and knowledge, those truly relevant to informed decision. (Ellis et al., 2004) [13]

From all of these, knowledge-based expert systems have the ability to capture specific knowledge of an area and to mimic human expert strategy to solve problems in that area. (Britton et al., 2005)[4] In the cited paper the concept of expert system is defined in a unique way. An expert system is, in the researchers vision, a computerized system which subscribes to the following logical syllogism: "*n* experts (somebodies) input their knowledge into the system. The system outputs its inputs to a non-expert (anybody else). A non-expert (anybody else) knows more than *n-1* experts (somebodies). In short, an expert system helps many somebodies turn anybody into a somebody." After this exciting presentation of the concept, the study's authors noted that developing an expert system appeal both to knowledge about human reason and the knowledge

about information technology, as a preamble to describe the design and characteristics of such solutions.

Numerous studies have evaluated the usefulness of fuzzy logic systems and neural networks in economic and industrial applications. (Lin et al., 2004) [21]. The three researchers even suggest an integrated neural fuzzy system to prevent the risk arising from misstatements of income, such as the U. S. well-known accounting scandals, Enron and WorldCom. In their study, Ellis et al., (2004), [13] states that, in agro-forestry, computer applications for decisions support reach their goals, when they aggregate various sources of information and relate its to user needs and resources. The complexity of natural resource management is given by the diversity of resources, interests, objectives, constraints or categories of owners involved. According to the authors, intelligent solutions for this area should take into account simultaneously environmental objectives, the production objectives of owners and society needs.

From a detailed analysis of forest decision support systems, Reynolds (2005) [32] concluded that, while in the early years its was designed to solve relatively simple problems of management, modern systems are required to meet the challenges generated by forestry ecosystem management, sustainability and adaptive management.

In his 2005 study, Reynolds looks at the key requirements for such systems in the U.S., the characteristics of such solutions in the U.S., how they succeed to meet requirements and existing opportunities for their development prospects. One of the three systems presented by Reynolds (2005) [32] is Ecosystem Management Decision Support System-EMDS. Created since 1994 by the U.S. Forest Service, EMDS is now developed by the Institute of Redlands University, California. This system integrates NetWeaver logical inference engine to evaluate forest planning and Criterium DecisionPlus decision modeling engine to assess management priorities. (EMDS Web page. <http://www.institute.redlands.edu/emds/Default.aspx>) [43].

These engines are used for creating the knowledge base and they are developed trademarks of Rules-of-Thumb Inc., and respectively, InfoHarvest Company.

(EMDS User Guide, <http://www.institute.redlands.edu/emds/manuscripts/docs/EMDS%20User%20Guide.pdf>) [43].

Criterium DecisionPlus combines a visual user interface, brainstorm site, a flexible mechanism for setting variables, ways of achieving the original analysis and generate comprehensive reports to help decision makers to formulate, validate and communicate complex decisions. Can be obtained decision importance criteria ratings, and standard queries, using the rules.(InfoHarvest Inc., 2002) [45].

Since 2009, the analysis carried out using EMDS, support the decision on forest-fuels budget allocation. Models used in the early development of the system were mainly oriented to bio-physical considerations, and included only a few socio-economic factors. Yet managers were more interested in using the results provided by these models to determine budget allocation to agencies and department regions. Regarding it, was found that it was necessary to expand the coverage of decision support solution to adequately address the multiple purposes for which it was designed. (Reynolds, 2010) [31]

So, after the use of expert systems in practical forestry, it is concluded that for best results, this type of systems should include information and accounting knowledge and be designed in the form of integrative solutions.

Slovakia set of decision support models for selection of harvesting treatment and selection of harvesting technology, OHTS (Optimal harvesting technology selection), includes both environmental and ergonomic criteria, as well as economic criteria. This system was developed in the NetWeaver environment, which is connected with EMDS solution. Models designed in the system are based on morphology terrain data (digital landscape model), information

about the structure of forest stands (age, species, varieties), soil type, type of forest roads and their condition, equipment usually used for harvesting in a given area, the costs of such operations.

Of economically point of view following criteria are considered: wages and taxation, depreciation, yield issues, repairs and maintenance, auxiliary materials costs, profits, losses that occur in harvesting. (Tuček and Majlingová, 2010)[36]

4. FORESTRY MANAGEMENT AND ACCOUNTING IN ROMANIA

Regarding the Romanian forestry policy in this area, only in 2002 started a Forestry Development Project, initiated by the Government with World Bank support, and according to documents published on the project web site (<http://www.forestier.ro> [47]), the objectives of project are:

[1] improving the management of state forests by expansion the capacity and technological innovation for sustainable environmental policies and efficient forest managent;
[2] assisting development of a pilot system for forest management in support of private forest owners.

To achieve the objectives were detailed five project components:

Component 1: Establish Systems to Ensure Sustainable Management of Private Forest Lands
1.a. Strengthening the Department of Forests, with emphasis on the Forest Inspectorates activity
1.b. Support for the Development of National Association of Private Owners (APPR)
1.c. Monitoring and information management system.

Component 2: Mitigate the Consequences of Restitution on Management of State Forest Land
2.a. Supporting Reform and Strategic Development of the NFA-Romsilva
2.b. Rehabilitating and expanding the forest road network

Component 3: Support Increased Productivity and Competitiveness of Forest Industries : establishing the Forest Business Information Center (ForsBIC)

Component 4: Building Public Support for Sustainable Forest Management : preparing and implementing a public awareness strategy and campaign

Component 5: Project Management and Monitoring.
(<http://www.forestier.ro>[47])

Within 1.c. Component, Bucharest INDACO company had the task of creating Forest Monitoring and Information Management System (FMIMS).

According to the company website, (<http://www.indaco.ro/resurse/prezentare/prezentare_ro.pdf> [44]), development of this system was based upon analysis of forest resources and forest land, technical, administrative and operational data, in order to achieve sustainable forest management objectives.

The system consists of three modules:

- FOR-MIS: model, gather and process information from the field (forest districts), providing multiple reports. This module operates based on a hierarchical organizational structure. FOR-MIS has an open architecture using a metadata-driven model (MDA);
- FOR-GIS is reporting and view in geographical format module, creating thematic maps based on information taken from the module FOR-MIS;

- FOR-CES – through this module the system model and store, at indicators level, the concept of an warehouse.
  (<http://www.indaco.ro/resurse/prezentare/prezentare_ro.pdf> [44])

Currently, this system is used to support decisions at the Ministry of Environment and Forests.

In the National Forest Agency (NFA), at this time, is not used a particular system to support decision, but it was decided to implement an integrated information system for introducing the relevant information in acquisitions, sales, warehouse, immobile assets and financial accounting. The system will provide reports to assist decisions for optimal performance of the Agency's current significant activities. (Contu, 2008)[8] The system to be implemented will be an Enterprise Resources Planning system , called *Charisma ERP* (Dinca and Miu, 2008)[10] and will have the following structure:

- General Accounting Module;
- Suppliers Accounting and Payments Module
- Customer Accounts and Receipts Module
- Immobile Assets Module
- Inventory Management Module
- Management Accounting Module
- Treasury Accounting Module
- Acquisitions Management Module
- Contracts Module
- Human Resources Module - personal inventory and payroll
- eAuction Module
- PDA Data Acquisition
- Data Timber Processing Management
- Web Portal
- Document Management.

(Contu, 2008) [8]

That computer solution aims to satisfy the following "business needs" (Contu, 2008) [8] :

PB1: Need for unified and centralized management of technical and economic data set to be stored and tracked in the computer system, removing additional activities, integration and homogenization of data received from the territory.

PB2: Necessity to achieve business flows and approved documents, from the activity objects of the NFA Romsilva in a uniform manner, using the computer system, for better coordination of technical and economic processes of NFA.

PB3: Lack of integrated information system leading to the inability to obtain necessary reporting to administrative authorities and policy makers (or obtaining with great difficulty).

PB4: Need to streamline business, financial and management process of NFA Romsilva.

PB5: Need to allow transparent forest acquisition management of NFA Romsilva (by facilities of informing the public) respecting the rules established by law for public auctions.

PB6: Need for real-time traceability of timber in production, transport and storage in RNP Romsilva activity.

PB7: Need to plan and to pursue the acquisition budget of RNP Romsilva according to law and according internal procurement procedures.

PB8: Annual evaluation of wood possibility of cutting streamlining.

PB9: Necessity to monitor the standing timber, harvested timber and purchasing services contracts. (Contu, 2008) [8]

To solve business problems and needs have been defined following described business goals to be reached by implementing the system:
OB1: IT components must use a single model, relational database model, so that different entities may not be duplicated in its.
OB2: IT system should enable management accounting information for a unit with complex structure, composed of several branches, orderly in several layers of decision, with operational, separate and cumulative reporting functions.
OB3: IT system will manage chart of accounts, and will integrate all accounting periods and accounting records.
OB4: The IT system will allow accounting information to be detailed, as an instrument for tracking and analysis of functional structure.
OB5: Providers accounting system must generate effective tools for control Romsilva payments, to optimize payments time and ensure a system of approving the payments. It must manage information about vendors, system to record invoices from suppliers, and other transactions (debit notes, credit, advance payments, etc.) .
OB6: Customer accounting module will provide support for customers activities, with the aim to achieve a rigorous control of the amounts due and received by NFA Romsilva. Module will manage customer information, both data definition and historical relations with them.
OB7: The IT system will include accounting of immobile assets, providing both financial functions (values, depreciation, transactions) and a transparent management of their physical (physical inventory, location in space).
OB8: The IT system will need to enable inventory management of items defined in the NFA Romsilva activity.
OB9: IT systems should include management accounting: the collection of direct costs and indirect costs, items of expenditure, automatic allocation of indirect costs and administrative overheads, outcome establishment.
OB10: IT system should provide a tool to achieve NFA Romsilva automatic cash-flow correction control and cash-flow forecast.
OB11: Acquisitions module should create supply optimization activities prerequisites and policies to ensure compliance with company conditions of supply work.
OB12: IT system should enable definition and monitoring of contracts, from negotiation phase until closure or annulment. (Contu, 2008) [8]

MOdels for AdapTIVE forest Management (MOTIVE) is a European project under Framework 7 for Research and Technological Development (FP7: ENV.2008.6.2.1.6. Development of models of adaptive forest management) that seeks an investigation into management strategies for climate and use of land changes adaptation.
This project takes place over four years, with completion in 2013, attended by 20 partners from 14 European countries, Romania is represented by a team from the Faculty of Forestry, University "Stefan cel Mare", Suceava. About the project, from the presentation on dedicated website, we find out that particular attention will be given to conditions of uncertainty and risk in terms of how they will be taken into account in improved systems, to assist decisions.
(MOTIVE 2010 Web page. <http://www.motive-project.net/index.php?P=42> [46]). Remains to be seen what degree of importance is assigned to accounting knowledge, in terms of the objectives of this project.

5. CONCLUSION

It requires, in Romania, to start a process of creating accounting knowledge-based intelligent systems to provide decision support to forestry managers. A first step in this direction would be to

build a forest specific accounting knowledge base for a forest district in order to improve decision making at this level.

REFERENCES

1. Abernethy, M., Bouwens, J.,"Determinants of Accounting Innovation Implementation", Abacus, (41),3, created 30 Sep. 2005, Wiley-Blackwell Publishing, online, <http://www3.interscience.wiley.com/cgi-bin/fulltext/118679508/PDFSTART>, accessed 27 Oct. 2009, pp. 217-233.
2. Andone, I., Dologite, D., Mockler, R., Ţugui, A.(2001), Dezvoltarea sistemelor inteligente în economie, Editura Economică, Bucureşti, pp.13-90.
3. Andone, I., Păvăloaia, D., Bâcâin, I., Genete, L.D.(2004), Modelarea cunoaşterii în organizaţii, Editura Tehnopress, Iaşi, pp.9-17.
4. Britton, G.. A., Tor, S. B., Zhang, W.Y., (2005), "Techniques in Knowledge Based Expert Systems for the Design of Engineering Systems", Intelligent knowledge-based systems : business and technology in teh new millennium, Vol. 4 : Intelligent System, Edited by Cornelius T. Leondes, Kluwer Academic Publishers, Massachusetts, USA, pp.3-11.
5. Bryant, B.P., Lempert, R.J., (2010), "Thinking inside the box: A participatory, computer-assisted approach to scenario discovery", Technological Forecasting and Social Change, Elsevier Ltd., (77),1, pp.34-49.
6. Buongiorno, et al., (2003), "The Global Forest Products Model (GFPM): Structure, Estimation, Applications", SOFEW, Mississippi State University, USA, online, accessed 23 Aug. 2010, <http://sofew.cfr.msstate.edu/papers/Buongiorno03.pdf>, pp. 252-262.
7. Chin K.S., et al., (2010), "Development of user-satisfaction-based knowledge management performance measurement system with evidential reasoning approach ", Decision Support Systems, Elsevier B.V., (48),2, pp.383-394.
8. Contu, M., (2008), " Specificatie de implementare Charisma Enterprise", TotalSoft S.A., Bucureşti, Versiunea 2.0, 87 p.
9. Davies, J., Richards M., (1999), "The Use of Economics to Assess Stakeholder Incentives in Participatory Forest Management: A Review", Report - European Union Tropical Forestry Papers 5, published by European Union, Overseas Development Institute London, online, <http://www.odi.org.uk/resources/details.asp?id=4654&title=economic-stakeholder-incentives-participatory-forest-management>, accessed 17 Aug. 2010, pp.1-55.
10. Dinca, C., Miu, F., (2008), " Manual de Training Utilizator Charisma Enterprise", TotalSoft S.A., Bucureşti, Versiunea 2.4, 390 p.
11. Ebers, M., Ganter, H.D., (2000), "Strategic Applications of Integrated Information Systems", Business Strategy and Information Technology, Edited by Ewan Sutherland and Yves Morieux, Routledge, London, pp.131-142.
12. Ekbia, H.R., Reynolds, K.M., (2007), " Decision Support for Sustainable Forestry: Enhancing the Basic Rational Model ", Sustainable Forestry: from Monitoring and Modelling to Knowledge Management and Policy Science, Edited by K.M. Reynolds et al., CAB International , Oxfordshire, UK, available online on U.S. Forest Service website, accessed 24 Aug. 2010, <http://www.fs.fed.us/pnw/pubs/journals/pnw_2007_ekbia001.pdf> pp. 497-514.
13. Ellis, E.A., Bentrup, G.., Schoeneberger, M.M., (2004), "Computer-based tools for decision support in agroforestry: Current state and future needs", Agroforestry Systems, 61, Kluwer Academic Publishers, Printed in the Netherlands, accessed 15 Mar. 2010 <www.unl.edu/nac/research/2004ellis.pdf>, pp. 401-421.
14. Eom, S., Kim, E., (2005), "A survey of decision support system applications (1995–2001)", Journal of the Operational Research Society, II (II), Operational Research Society Ltd., UK,

available online at <http://cstl-hcb.semo.edu/eom/research/dss3surveyARTICLE.pdf>, accessed 24 Aug. 2010, pp. 1-15.
15. Godsey, L.D., (2010), "Economic Budgeting for Agroforestry Practices", Agroforestry in Action, , revised March 2010, University of Missouri Center for Agroforestry, USA, online, <http://extension.missouri.edu/explorepdf/agguides/agroforestry/af1006.pdf>, Accesed 22 Aug. 2010, pp. 1-12.
16. Huang, G.H., et al., (2010), "Development of a decision-support system for rural eco-environmental management in Yongxin", Environmental Modelling & Software, Elsevier Ltd , (25),1, pp.24-42.
17. Jöbtl, H. A., (2008), "Can Traditional Forestry Accounting Contribute to Measuring the Sustainabiliy of a Forest Enterprise ?", The Multifunctional Role of Forests Policies, Methods and Case Studies, Edited by Cesaro L., Gatto P., Pettenella D., EFI Proceedings No.55, European Forest Institute Portal, <http://www.efi.int/portal/virtual_library/publications/proceedings/55/>, accessed 17 Aug. 2010, pp.183-194.
18. Kangas, A., Kangas, J., Kurttila, M., (2008), Decision Support for Forest Management, Springer Science Netherlands, pp.1-7, 47-50.
19. Kazana, V., Kazaklis A., (2008), "Spatial Scale and Aggregation Level Consideration for Forest Resource Impact Evaluation in the Context of Sustainable Forest Management", The Multifunctional Role of Forests Policies, Methods and Case Studies, Edited by Cesaro L., Gatto P., Pettenella D., EFI Proceedings No.55, European Forest Institute Portal, <http://www.efi.int/portal/virtual_library/publications/proceedings/55/>, accessed 17 Aug. 2010, pp.205-216.
20. Lien, D., Shrestha K., "A New Information Share Measure", Journal of Futures Markets, 29, created 23 Jan. 2009, Wiley Periodicals, Inc., online, accessed 19 Oct. 2009, <http://www3.interscience.wiley.com/cgi-bin/fulltext/121659931/PDFSTART>, pp. 377-379.
21. Lin, J. W., Hwang M. I., Li, J.F., (2004), "A Neural Fuzzy System Approach to Assessing the Risk of Earnings Restatements ", Issues in Information Systems,Vol. V, International Association for Computer Information Systems, IIS 2004 CD Homepage, accessed 05 Sep. 2010, available online <http://www.iacis.org/iis/2004_iis/PDFfiles/LinHwangLi.pdf>, pp.201-208.
22. Lubello, D., (2008), "A rule-based SDSS for integrated forest harvesting planning", PhD Thesis, Istitutional Repository for University of Padova Research Works, created 09 Sep. 2008, University of Padua - Department of Land Use and Agroforestry Systems, Italy, <http://paduaresearch.cab.unipd.it/262/>, accessed 16 Aug. 2010.
23. Ma, J., et al.,(2010), "Decider: A fuzzy multi-criteria group decision support system", Knowledge-Based Systems, Elsevier Ltd., (23),1, pp.23-31.
24. May, H.K., Conery G. S., (2003) "FOREST: A System for Developing and Evaluating Ecosystem Simulation Models", Summer Computer Simulation Conference 2003, Montreal, online,accessed 27 Nov. 2009, <http://www.cs.rpi.edu/~szymansk/theses/S043_Conery.pdf>, pp. 119-127.
25. Mikolajuk, Z., Gar-on Yeh, A., (2000), "Sustainable Development and Decision Support Systems", Decision Support Systems for Sustainable Development, Edited by Gregory E. Kersten et al., Kluwer Academic Publishers, Ottawa, Canada, pp.13-22.
26. Mowrer, H. T., et al., (1997) "Decision support systems for ecosystem management, an evaluation of existing systems.", U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Ft. Collins CO., RM-GTR-296, online, Accessed 16 Aug.2010, <http://www.fs.fed.us/rm/pubs_rm/rm_gtr296.pdf>, pp. 1-154.
27. Pearce, D.W., Putz F., Vanclay, J.K., (2002), "Is sustainable forestry economically possible? ",

Valuing the Environment in Developing Countries: Case Studies, Edited by D. Pearce, C. Pearce and C. Palmer, Edward Elgar, Cheltenham, pp. 447-500
28. Pomerol, J.C., Adam, F., (2003), "From Human Decision Making to DMSS Architecture", Decizion Making Support Systems Achievement and Chalenges for the New Decade, Edited by Manuel Mora et al., Idea Group Publishing, London, UK, pp.40-61.
29. Ragothaman, S., Naik, B.,Ramakrishnan, K., (2002), "Using Rule Induction for Expert systems Development: The Case of Corporate acquisitions," Proceedings Midwest Decision Sciences Institute, Milwaukee, WI, USA, April 2002.
30. Rauscher, H. M., Schmoldt, D. L., Vacik, H., (2007), " Information and knowledge management in support of sustainable forestry: a review ", Sustainable Forestry: from Monitoring and Modelling to Knowledge Management and Policy Science, Edited by K.M. Reynolds et al., CAB International , Oxfordshire, UK, available online on U.S. Forest Service website, accessed 24 Aug. 2010, <http://www.srs.fs.usda.gov/pubs/ja/ja_rauscher008.pdf> pp. 439-460.
31. Reynolds, K.M., (2010), " Critical Factors Behind Success of the EMDS System and experiences in Design and Use", in Falcao. AO, Rosset. C (eds.) Proceedings of the Workshop on Decision Support Systems in Sustainable Forest Management, Lisbon, Portugal, OP1, available on line <http://www.fc.ul.pt/dsfm2010/docs/presentations/paper_1.pdf>, accessed 03 Sep. 2010
32. Reynolds, K.M., (2005), " Integrated decision support for sustainable forest management in the United States: Fact or fiction?", Computers and Electronics in Agriculture, 49, Elsevier, available on line <http://www.institute.redlands.edu/emds/manuscripts/pdf/compag2005.pdf>, accessed 18 Jul. 2010, pp.6-23.
33. Reynolds, K.M., (1999), " NetWeaver for EMDS user guide (version 1.1): a knowledge base development system", General Technical Report PNW-GTR-471, Portland, OR, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, on line <http://www.institute.redlands.edu/emds/manuscripts/pdf/gtr471.pdf>, accessed 03 Sep. 2010, pp.1-63.
34. Reynolds, K.M., et al, (2008), "Decision Support Systems in Forest Management", Handbook on Decision Support Systems 2,Edited by Burstein F., Holsapple C. W., Springer-Verlag Berlin Heidelberg, pp.499-523.
35. Toppinen, A., Kuuluvainen, J., (2010), "Forest sector modelling in Europe—the state of the art and future research directions", Forest Policy and Economics, Elsevier B.V., (12),1, pp.2-8.
36. Tuček, J., Majlingová, A., (2010), " Decision support tools in forest management in Slovakia", in Falcao. AO, Rosset. C (eds.) Proceedings of the Workshop on Decision Support Systems in Sustainable Forest Management, Lisbon, Portugal, PP11, available on line <http://www.fc.ul.pt/dsfm2010/docs/posters/paper_49.pdf>, accessed 03 Sep. 2010
37. Turland, J., (2007), "An Overview of North American Forest Modeling Approaches and Technology and their Potential Application to Australian Native Forest Management. Project PG06-5046: Growth and Yield Modeling and Harvest Scheduling in Uneven-aged Mixed Species Forests", 2006 WORLD FOREST INSTITUTE FELLOWSHIP REPORT, The World Forestry Center Portland, Oregon, USA, online, accessed 23 Aug. 2010, <http://wfi.worldforestry.org/media/publications/specialreports/Modeling_Turland.pdf>pp.1-10; pp. 31-50.
38. Turland, J., (2007), " Technology and their Potential Application to Australian Native Forest Management, Project PG06-5046: Growth and Yield Modeling and Harvest Scheduling in Uneven-aged Mixed Species Forests", World Forest Institute, Portland, SUA, online, <http://wfi.worldforestry.org/media/publications/specialreports/Modeling_Turland.pdf> accessed 04 Sep. 2010, pp.1-36.
39. Willows, R., et al, (2003), "Climate adaptation: Risk, uncertainty and decision-making. UKCIP

Technical Report", Edited by Robert Willows and Richenda Connell, UK Climate Impacts Programme, Oxford, online, accessed 22 Aug. 2010, <http://environment.msu.edu/climatechange/UK_CC_Decisions_Report.pdf> pp.1-18; pp. 41-66 ; pp. 89-108.

40. Zhu,Y., Zhang, J., Li1, S., Xue, L., Liu, S., Xue, Y., (2007), "Agriculture and forestry economy decision support system based on agent", New Zealand Journal of Agricultural Reasearch, 50, The Royal Society of New Zealand, pp.1339-1346.
41. *** COST Action FP0804. Home page. 26 Mai 2009 <http://fp0804.emu.ee/>, accessed 26 Oct. 2009.
42. *** DSFM 2010 - Workshop on Decision Support Systems in Sustainable Forest Management. Home page. <http://www.fc.ul.pt/dsfm2010/>, Faculty of Sciences of the University of Lisbon, Portugal, webpage, accessed 4 Sep. 2010.
43. *** EMDS - Ecosystem Management Decision Support System.Web page. <http://www.institute.redlands.edu/emds/Default.aspx>, The Redlands CA USA University's Institute webpage, accessed 4 Sep. 2010
44. *** Indaco Systems . Web page. Companie Page. Accessed 26 Oct. 2009.<http://www.indaco.ro/resurse/prezentare/prezentare_ro.pdf>.
45. *** InfoHarvest Inc., "Goal Oriented Queries: the next level in effective Query Management", Updated: 8/06/2002, InfoHarvest Inc. Products Page, accessed 3 Sep. 2010, <http://www.infoharvest.com/ihroot/infoharv/WDObj/GoalOrientedQueries.pdf.>
46. *** MOdels for AdapTIVE forest Management (MOTIVE). Home page. 2010. <http://www.motive-project.net/index.php?P=42>, accessed 4 Sep. 2010.
47. *** Proiectul de Dezvoltare Forestiera. Web page. 2007. <http://www.forestier.ro>, accessed 23 Aug. 2010.