Scandinavian Forest Economics
No. 42, 2008

Proceedings
of the Biennial Meeting of the
Scandinavian Society of Forest Economics
Lom, Norway, 6th-9th April 2008

Even Bergseng, Grethe Delbeck,
Hans Fredrik Hoen (eds.)
Ås
What Contributes to a High Satisfaction of Report Publishers? An Approach with a Bayesian Belief Network

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Abstract

The evidence of social and ecological responsibility has gained importance in the forest product industry. Sustainability Reporting could be seen an approach, which is able to capture effort and success of enterprises not only within financial dimension. New types of multidimensional reports have been developed in the last decade. However, little is known about reasons for the restrictive use of the new report types and it remains open if the new types are applicable in the forest products industries.

Therefore, in order to gain deeper knowledge in this respect a survey was conducted involving 400 forest products enterprises located in Germany, Switzerland and Austria. Special attention was given to attitudinal and behavioural questions. Furthermore, results were analyzed with a Bayesian Belief Network (BBN) which helped to detect the key components that can explain the various level of satisfaction with reporting.

As the results indicated, generally low satisfaction with the present reporting was concluded. Moreover, the BBN based sensitivity analysis provided evidence that (e.g.) a positive attitude towards new reporting standards and the publication of such new multidimensional reports increases the utility perceived significantly. On the other hand, strong negative influence was found for the publication of traditional report-types. Hence, BBN proved to be a feasible approach to explain the inner relationships and its explanatory power.

General recommendations for the future reporting in the forest product sector can be deduced.

Keywords: Reporting, Bayesian Belief Networks, Satisfaction with current reporting.
Introduction

Compared with the situation of few decades ago, noteworthy increase of control of enterprises by society has been observed. Particularly the outcome of Rio Conference in 1992 forced enterprises to deal constructively with the issue of sustainability (Cahyandito, 2005). Attention of the public is given to the social and ecological performance of enterprises, rather than to the economical success. Therefore implementation of corporate responsibility (CR) strategies is of benefit to the enterprises (Loew et al., 2004).

However, it has not always been sufficient to implement such a strategy. According to a German saying 'act well, and talk about it', it is assumed that there exists a need to communicate efforts and success to the public. As a consequence, European commission recommended the implementation of new report-types (EU, 2001).

Consideration of new reporting schemes or the integration of non-financial content in traditional report-types are not really new. During the last decades many attempts were undertaken to integrate non-financial content into business reports. This lead to different types of reports such as social, environmental and sustainability reports. The various national and sector initiatives and reporting traditions produced unmanageable number of types, subtypes and individual reporting schemes, which lead to poor acceptance and lack of their comparability. In this respect the EU-commission indicated a need for the standardisation of contents, format and auditing of the individual report’s quality (EU, 2001). Since 1999 the Global Reporting Initiative (GRI, 2002) developed an international reporting scheme for sustainability reporting. This approach has been increasingly accepted. Meanwhile more than 2500 reports using this standard were published worldwide. As far as concerned in the forest products sector this standard is up to now mainly confined to the industrial sector. Despite this fact few forest enterprises (producers of round-timber and forest contractors) have adopted sustainability reporting (e.g. ÖBF, 2005; Terranova, 2004; Coillte, 2003). The frequency in the wood processing industries is higher, however, still not to high.

Results of preliminary studies indicated that there is only little known on reporting in the forest products industries. In the context with an evaluation focussing on the present state of reporting and on the attitudes of the publishers towards some of these new approaches mentioned above (Hartebrodt and Wedel, 2006), the idea came across, to put these findings into a causal relationship.

The present paper contributes to the question, which the key-components are that can explain the satisfaction of the publishers in terms of the report-utility perceived. In this context we highlight the question as well, whether new multidimensional report types and concepts like standardisation of reports, participation and a higher transparency can be expected to improve the effectiveness of reporting.

The paper is structured as follows. In the first paragraph the brief introduction in the history of reporting in the forest sector is presented. In the second step the research gaps are outlined. The third paragraph contents description of the material and the theory of Bayesian Belief Network.
(BBN). In later paragraphs the preliminary network, BBN based sensitivity analysis and results are presented. Conclusions are drawn and recommendations for future reporting activities are derived in the final paragraph.

State of Reporting in Forest Industry

Reports play a substantial role in the communication strategies of enterprises. While a relevant number of enterprises issue reports, there is poor knowledge about the satisfaction of the publishers with their reports issued and the utility of this instrument.

For centuries the documentation of the volume harvested and sometimes the related revenues from timber selling dominated the reporting within the forest sector (Brandl, 1970). The years after World War II can be characterized as a period, where the statistical documentation of silvicultural activities and timber volumes has been prevalent (e.g. LFV 1955, RLP 1957). Reports of wood based industries reports have consisted mainly of balance sheets, based on national and mandatory accounting standards.

In the seventies some attempts have been undertaken to integrate, for instance, social aspects (LFV 1980, Kenk 1975). A new trend started after Rio-Conference and led to an increasing number of reports (in forest products industries), containing also ecological and again social aspects. In this respect it can be stated that Sustainability Reporting gained slowly but increasingly on importance.

New developments such as stakeholder participation, standardization of reports, approaches that lead to a higher transparency, are not very common down to the present day in the narrower forest sector and the wood-processing industries.

Research Gaps

While the publication of reports requires considerable amount of time and money, it is astonishing that almost no relevant discussion on the present state of reporting and the satisfaction of the publishers exists. What is more, no evidence for a single publication on the effectiveness of this instrument in the forest and wood based sector in the German speaking region was found.

Present research in other trade lines focused on the quality (e.g. Loew et al., 2005) or perception of sustainability reports (e.g. PLEON, 2003). Generally speaking it has been argued in this study that new types of report are gaining importance, especially in larger enterprises, which adopt increasingly international reporting standards and thus mostly the standards of the Global Reporting Initiative (GRI, 2002, 2006). However this trend followed insofar traditional patterns, as the implementation is frequently done without any critical reflection on the strength, weakness, opportunity and threats related to the adoption of these new report types.
Material

The survey was based on a structured questionnaire. Enterprises which were expected to have published reports were included. This sourcing was based on a literature and internet-study. The survey started on June 28th and finished on September 30th, 2005. The whole population amounted to 412. After nine weeks all enterprises received a reminder. We had 130 questionnaires completed (Table 1), which results into overall response rate of 32%.

Table 1: Sub-collectives, population and response-rates

<table>
<thead>
<tr>
<th>Sub-Collective</th>
<th>Public Forests</th>
<th>Private Forests</th>
<th>Contractors</th>
<th>Sawmill</th>
<th>Industry</th>
<th>Pulp and Paper Ind.</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>26</td>
<td>34</td>
<td>10</td>
<td>73</td>
<td>52</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>13</td>
<td>18</td>
<td></td>
<td>53</td>
<td>17</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>28</td>
<td>6</td>
<td></td>
<td>63</td>
<td>19</td>
<td>116</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>67</td>
<td>58</td>
<td>10</td>
<td>189</td>
<td>88</td>
<td>412</td>
<td></td>
</tr>
<tr>
<td>Responses [N]</td>
<td>43</td>
<td>25</td>
<td>12</td>
<td>16</td>
<td>34</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Response [%]</td>
<td>64</td>
<td>43</td>
<td>120</td>
<td>8</td>
<td>39</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

The main focus of the survey was on demographic aspects of the individual enterprise, objectives and target groups of the present reporting. In addition, the appraisal of basic objectives and structures of sustainability reporting was assessed and the perception of different indicators based on an excerpt of the GRI-indicator set was questioned. We received frequency distributions with regard to the present reporting strategies (e.g. type of reporting, size of the enterprise). The perception of the multidimensional reporting approach and the GRI-indicators was tested using a four point (forced) Likert scale, with subject-related response scales. The detailed results were further reported in Hartebrodt and Wedel (2006, accepted) and Hartebrodt and Kenntner, (2008; accepted).

Methods

Bayesian Belief Networks (BBN, syn. Causal Probabilistic Networks, Bayes Nets) are statistical models, which are designed to visualize complex statistical structures of dependent items. The Bayesian Network originates in the Bayes theorem of so called dependent probabilities (Bayes, 1793). Each Bayesian network consists of a set of nodes and a set of directed edges between these nodes (see Fig. 1). Edges reflect cause-effect relations within the domain. The effects are normally not completely deterministic (e.g. disease → symptom). An important fact is that the strength of an effect is modelled as a probability (Jensen, 2007).

A great advantage of Bayesian networks is that the meaning of a node and its causal probability tables (CPT) can be subject of external discussion,

\footnote{In case of narrower interest, please contact the corresponding author.}
regardless of their function in the network. The CPTs can be informed by several kinds of information like expert knowledge, surveying results or empirical evidence. From the analytical point of view every item can be subject of prognostication or seen as influence factor.

Example

One of the most prominent examples is the so called ‘Apple Jack example’. ‘Apple Jack’ notices that his trees are loosing their leaves. He is aware of two potential reasons only: Drought and a (plant-) disease. This leads to the following BBN and its related CPTs and edges (Fig. 1).

Drought and disease are so called parent (explaining) nodes to the dependent node ‘losses’. Each node requires causal probability tables (CPT). For the parent nodes only two probabilities for ‘yes’ and ‘no’ are required. The CPT for the depend node ‘Losses’ is rather more complex, as each potential case with its related probabilities needs to be specified. After the edges or ‘causal arrows’ are introduced, the nodes are linked and the BBN can be used for different kind of analysis. Subsequently, the sensitivity analysis was used. Example shows that the present state a total probability that the tree will basically loose his leaves is $p = 0.305$. This probability is called a priori probability. If the probability of drought or disease is changed to the extremes 0.0 (no/yes) and 1.0 (yes/no), the model is able to predict the related, so called a-posteriori probabilities (e.g. by watering or chemical measures) (Tab. 2).
Table 2: Sensitivity analysis of the ‘Apple Jack Example’

<table>
<thead>
<tr>
<th></th>
<th>Drought yes/no</th>
<th>Loss</th>
<th>Disease yes/no</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum likelihood</td>
<td>1.0/0.0</td>
<td>0.870</td>
<td>1.0/0.0</td>
<td>0.830</td>
</tr>
<tr>
<td>Present State</td>
<td>0.2/0.8</td>
<td>0.305</td>
<td>0.2/0.8</td>
<td>0.305</td>
</tr>
<tr>
<td>Minimum likelihood</td>
<td>0.0/1.0</td>
<td>0.176</td>
<td>0.0/1.0</td>
<td>0.186</td>
</tr>
<tr>
<td>Difference</td>
<td>1.0/1.0</td>
<td>0.694</td>
<td>1.0/1.0</td>
<td>0.644</td>
</tr>
</tbody>
</table>

Table 2 above shows that the difference of losing the leaves between the maximum and minimum probability of drought is higher (0.694) compared with the difference of losses when the trees are diseased (0.644). Therefore evidence is given that watering would be more effective in order to reduce the risk of loss of the leaves.

A Preliminary Network

We designed a preliminary BBN with the report utility perceived by the publishers as depended variable, as a strong indicator for the satisfaction of the enterprises issuing reports. The influence factors (parent nodes) can be clustered into three groups (see Fig. 2).

The first group of items contains factors, which are related to the new approaches in reporting. The overall attitude of such new ‘reporting standards’ is itself determined by the attitude towards transparency, participation in report-design and –process and the attitude towards multidimensional reporting concepts. The attitude towards multidimensionality is determined by the attitude towards different report contents in terms of economical, ecological and social information. All items are binary (positive or negative attitude).

As an influence of the target and actual readers is expected, the readership and the overlap between topical readership and target-readership as relevant influence factors are integrated. Figure 2 shows additionally five important stakeholder groups as potential readers, whereas the overlap between target and actual readership is binary coded.

The third cluster is formed by items, which characterize the present reporting and its framework. Included are present report types, the question, whether a report has been issued recently and the size of the enterprise as an important precondition that can be expected to take influence on the willingness and/or ability to publish reports. We had five relevant report types included in the underlying survey (business reports, balances, environmental reports, social reports and sustainability reports) and four groups for the size of the enterprise (in terms of the number of employees).

The utility perceived (as outcome or objective node) was ranked high, medium or low.
Results

The sensitivity analysis for each item and each status was undertaken. In this respect, 23 sensitivities from which 14 showed a positive difference with regard to the probability perceiving a high utility of reporting were identified. In nine cases a negative impact was found.

Positive Impacts

Table 3 depicts the findings concerning items, which showed a positive influence on the satisfaction. The ranking with regard to the maximum absolute value of ‘high satisfaction’ and the sensitivity is very similar. However the item ‘attitude to new reporting standards’ and in some way the item ‘readership employees’ did not prove the same (see arrows in tables 3).

The difference (p = 0.106) in satisfaction between the interviewees who showed a positive attitude to the new standards and those who did not, was the highest with. This is not related to a high satisfaction of those who showed a positive attitude, but related to a rather low satisfaction of those who did not (p of high utility = 0.144)

It became evident, that all publishers who issued new and/or multidimensional report types (social, environmental, sustainability) had a higher probability to perceive a higher degree of satisfaction, among p = 0.090 and 0.073.

As relevant identified were found also the capability to address politicians and customers, a better overlap between actual and target readership, and a positive attitude towards participation in the reporting process.

Lower amounts in positive satisfaction showed the attitude towards multidimensionality and a high importance of employees as current report-readers.
Table 3: Items with a positive impact on satisfaction of reporting

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute Ranking</th>
<th>Sensitivity Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive attitude new standards</td>
<td>0.106</td>
<td></td>
</tr>
<tr>
<td>Report type: Social Report</td>
<td>0.324</td>
<td>0.090</td>
</tr>
<tr>
<td>Report type: Environmental</td>
<td>0.307</td>
<td>0.077</td>
</tr>
<tr>
<td>Report type: Sustainability Report</td>
<td>0.304</td>
<td>0.073</td>
</tr>
<tr>
<td>Readership: Politicians</td>
<td>0.283</td>
<td>0.058</td>
</tr>
<tr>
<td>Overlap target and actual Readers</td>
<td>0.281</td>
<td>0.057</td>
</tr>
<tr>
<td>Readership customers</td>
<td>0.264</td>
<td>0.032</td>
</tr>
<tr>
<td>Positive attitude new standards</td>
<td>0.250</td>
<td></td>
</tr>
<tr>
<td>Positive attitude participation</td>
<td>0.247</td>
<td>0.027</td>
</tr>
<tr>
<td>Readership Employees</td>
<td>0.245</td>
<td></td>
</tr>
<tr>
<td>Attitude multidimensionality</td>
<td>0.239</td>
<td>0.014</td>
</tr>
<tr>
<td>Readership Employees</td>
<td>0.013</td>
<td></td>
</tr>
</tbody>
</table>

Negative Impacts

Only weak distinctions between the ranking according to the sensitivity and to the absolute level of satisfaction were identified. 46% of the enterprises published traditional reports. Contrary to the expectations that could be derived from the frequency of the report type, this item showed the most relevant negative effect with regard to the modelled satisfaction and its difference. A highly negative influence of the public and the branch members as actual readers was found. Based on the findings, mainly enterprises with 50-249 employees showed difficulties with their reports (Table 4).

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2 Only Items with a sensitivity p > 0.01 are listed.
Table 4: Items with a negative impact on satisfaction reporting

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute Ranking (by share ‘high satisfaction’)</th>
<th>Sensitivity Ranking (by difference max to min likelihood of item)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report type: Business report</td>
<td>0.204</td>
<td>-0.038</td>
</tr>
<tr>
<td>Readership: Public</td>
<td>0.190</td>
<td>-0.055</td>
</tr>
<tr>
<td>Readership: Branch Members</td>
<td>0.197</td>
<td>-0.052</td>
</tr>
<tr>
<td>Enterprise size 50 to 249</td>
<td>0.205</td>
<td>-0.038</td>
</tr>
</tbody>
</table>

Discussion and Conclusions

Discussion

Current reporting activities in forest product industries follow traditional patterns of reporting. Only a small number of enterprises deals constructively with new approaches. However the results of the study provided evidence that this can’t be the result of a high satisfaction with the present state. On the contrary it can be stated that a complete abdication of reporting would (theoretically) enhance the satisfaction with reporting notably. It could be concluded that the reporting is more driven by habituation than by conviction.

It could be observed that with increased use of traditional pattern in reporting the probability of low utility perception increases. Contrary to that the presented study identifies a coherent pattern that indicates that new approaches in reporting can be expected to enhance the satisfaction notably. A positive attitude towards new standards showed the highest sensitivity. The satisfaction of enterprises which issue such new reports (social, environmental and sustainability reports) showed the best absolute ranking in respect of their general satisfaction with reporting.

Remarkable is that the ability to address external readership-groups like politicians and customers were also relevant. However in the present state the reports are mainly read by members their institution. The results showed (Tab. 4) a low satisfaction when we are looking to the answers of interviewees who stated that this group is the most important one. Similarly a low overlap between the topical and the target readership explained additionally why there is a general problem with the accuracy of the present reports.

Methodological Aspects

Generally application of BBN as a suitable approach to analyse data, which are mainly confined to attitudinal aspects could be confirmed. Sensitivity analysis allowed a very clear and rapid distinction between

3 Only items with a sensitivity p > 0.01 are listed
factors, which determine the utility perceived notably and those which did not. The BBN was able to form a very coherent pattern to explain the key explaining components.

After we used these results as a base for a discussion with decision makers of a larger State forest enterprise, we agree with Smith et al. (2007) that these networks allow as well the involvement of stakeholder, or as done in the present case, of decision makers. The visualisation of the network facilitates the explanation of the results and enhanced the willingness of decision makers to adopt new approaches to a larger extent.

Some limitations arose, particularly the amount of data required and the (semi-) hierarchical structure of the network.

Despite the fact that we had 130 data sets available, it was only partially possible to inform the network completely. The more parent nodes and individual status were involved the higher was the risk of missing information in the nodes. A three-parent/three-status node leads to a $3^3 = 81$-field matrix. It occurred even in the case of a more or less uniform frequency of the individual cases that parts of the matrix remain empty or weakly informed. These ‘missing links’ could have affected the sensitivity analysis notably.

In accordance with Smith (2007) it can also be stated that larger BBNs tend to dilute the influence of the individual factor. The closer a node is to the outcome or objective node, the stronger his influence is. When doing sensitivity analysis the position of the node in the network has to be kept in mind.

Conclusions

Reporting in the forest product industry is present only partially goal oriented. The reporting enterprises invest a large amount of time and money, but achieve rather poor effect. Therefore a traditional understanding of reporting can be challenged by the increasing demand of society of information on the ecological and social performance of the institutions and/or enterprises. Especially in the case of the forest enterprises it can be argued that there is a risk that the inventors of sustainability seem to avoid a critical review of these issues.

As it stands, one might ask question about where to start in revising of reports and/or reporting activities. In the present study it has been argued that there are a relevant number of hints that new approaches in reporting have the potential to improve the satisfaction notably. Despite the fact that only a limited number of enterprises have had experience with new types of reporting (e.g. social reporting, environmental reporting, sustainability reporting), the results showed that these standards can be expected to enhance notably the global satisfaction with reporting. Therefore it was not surprising that positive attitude towards the basic concepts of new report types (participation, multidimensionality, transparency) caused the same effect.

Communication theory underlines the need to identify the target readership and their specific information demand. Thus, the enterprises have to put more effort in the identification of their main stakeholder groups. A
better overlap between topical and target readership could be another relevant factor to increase the satisfaction with the reports.

In summary it can be concluded that the knowledge about the information demand of the different stakeholder-groups is poor, or not existing. Therefore the identification of the perception of the various reports-types in different stakeholder groups and their attitudes towards the basic concepts of sustainability reports has to be analysed in order to meet the demand of a bi-directional communication between report-publishers and recipients.

References


