FORAC

Research Note

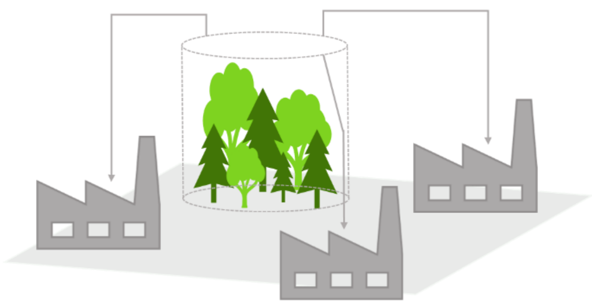
V.1, n°1, May 2024

Improving collaborative planning of a forest supply network: the potential of advanced planning in a system-integrator context

Pedro Eboli M.Sc., **Luc LeBel** (Director), **Luis Antonio de Santa-Eulalia** (Co-director)

Introduction

Natural and extensively managed forests allow for the supply of raw materials to a diversified forest industry. In such a context, mills may share the same procurement areas while having different supply needs (Beaudoin et al., 2010). This context imposes challenges concerning the alignment between forest planning and the harmonization of mill supply needs, as well as the coordination of forest operations (Mosconi, 2014).



The industry's public forest supply context (adopted from Morin, 2019)

One approach to improve procurement planning process in such a context is by employing a system-integrator, a third-party organization responsible for collaborative, fair, and neutral planning in the supply chain (Morin, 2019). Another available means of improving forest planning is the use of mathematical optimization methods (Rönnqvist et al., 2023).

However, the full potential of the system-integrator concept remains poorly explored in the scientific literature and forest planning performed by the system-integrator using mathematical optimization methods have not yet been the subject of a scientific study. The objective of this research is to evaluate the impact of mathematical optimization tools on the roles and characteristics of a system integrator when planning the supply for a multi stakeholder, multi product forest network.

Method

We conducted this study in partnership with Gestion FORAP, a forest management company that acts as a system integrator. It is responsible for annual wood supply planning for a network of 11 processing mills. First, we modeled the supply network on LogiLab, a mathematical optimization tool developed by FORAC, with the aim of quantifying the benefits of optimization tools to support the planning decisions made by the system integrator, as well as the planning process carried out by the latter. Secondly, we conducted interviews with procurement planners of the mills that form this supply network, to obtain their views on the impact of the use of mathematical optimization tools on the roles and characteristics of the system integrator.

Results and discussion

The use of the planning tool has reduced the time needed to select harvest blocks from 4 weeks to less than a week, taking into account the time needed to prepare the data and run the optimization. We took into account all operational and mill balance constraints, while minimizing transport distances and selecting blocks for a two-year planning period. The selection of harvest blocks by a system-integrator equipped with the optimization tool can reduce average transport distances between harvest blocks and mills by up to 15.44%, compared with the selection made by the integrator without the optimization tool. In addition, the selection made by a system integrator equipped with the tool shows a better balance of average hauling distances, balsam fir, thinning blocks and average diameter per stem between softwood mills. The following table presents the comparison of resources balance made by the system-integrator without the optimization tool and with the tool, for softwood mills of the network.

Comparison of resource balance between softwood mills

Selection made without the optimization tool					
Softwood mills	1	2	3	4	CV
Average distances (km)	53.4	53.4	46.3	45.1	0.08
Balsam fir (%)	58.0	58.0	46.9	31.4	0.22
Thinning blocks (%)	26.3	26.3	23.7	23.7	0.05
Average dm^3/stem	155.5	155.5	127.6	118.5	0.12
Selection made with the optimization tool					
Softwood mills	1	2	3	4	CV
Average distances (km)	48.9	52.3	45.7	44.6	0.06
Balsam fir (%)	53.5	44.1	37.5	43.5	0.13
Thinning blocks (%)	22.6	22.7	26.8	27.6	0.09
Average dm^3/stem	142.9	130.3	141.8	145.4	0.04

The planners interviewed mentioned that a system-integrator equipped with optimization tools is capable of promoting greater fairness between mills, encouraging planners to coordinate different sources of supply, making the planning process more agile and flexible, facilitating discussions between the various stakeholders, and improving supply predictability. In addition, the system integrator would be more impartial, credible and transparent.

Conclusion

The results obtained lead us to conclude that a third-party SI equipped with such a tool can achieve superior wood supply plan and improve the planning process on a multi-stakeholder and multi-product network. The findings on this paper are useful for forestry supply chain procurement planners, government participants in forestry planning and other stakeholders involved in similar supply chain planning. Moreover, from a scientific perspective, not only does our findings enrich the literature related to modeling of a multi-stakeholder and multi-product networks and to the SI contribution to supply chain planning, but also provides an example of Design Science Research methodology merging both quantitative and qualitative approaches in the field.

Literature

Beaudoin, D., Frayret, J.-M. et LeBel, L. 2010. Forest Policy Economics, 12(2), 79–93.

Morin, F. 2019. Planification collaborative dans l'environnement multiacteur public-privé des chaînes d'approvisionnement forestier du Québec: perspectives systémique, sociologique et informationnelle [Thèse de doctorat, Université Laval].

Mosconi, E. P. 2014. L'apport d'une approche multidimensionnelle de gestion des connaissances à la performance décisionnelle des organisations [Thèse de doctorat, Université Laval].

Rönnqvist, M., Martell, D., Weintraub, A. 2023. International Transactions in Operations Research, 30(6), 3296-3328.

Examiner 1 : Rémi Georges

Examiner 2 : François Morin

Editor : Shuva Gautam