Advantage
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Contents



# The *Opti-Grade*® grading-management system

**Abstract**

FERIC's *Opti-Grade* grading-management system can reduce grading costs by continuously measuring the condition of the road so as to identify sections that require the most maintenance and by concentrating maintenance efforts on those sections. Eighteen systems are already in service across Canada and the users report savings in grading costs on the order of 25%. *Opti-Grade* also lets managers determine the impact of the road's condition on travel speeds and justify the rehabilitation of problem sections.

**Keywords:**

*Opti-Grade*, Grading-management system, Road maintenance, Planning, Optimization.

**Authors**

**Steve Mercier and Mark Brown**
Eastern Division

## Introduction

Haul distances are increasing continuously, and the trend towards partial cutting and dispersed cut blocks will require road networks to be extended even further in coming years. This imposes considerable pressure on the road maintenance team, who must control costs and ensure the safety of users of the roads despite dwindling resources. Traditionally, graders performed systematic maintenance of the main road from start to finish, irrespective of the road's condition (Figure 1).

A previous FERIC study of grading management (Provencher and Méthot 1994) developed the concept of grading only as required and on a variable schedule. Potential reductions in grading times of 30% were identified in this approach, which targeted only the roughest sections of the road. However, optimization of the grading work required precise, ongoing knowledge of the condition of the road network. It is difficult and uneconomical for maintenance managers to patrol a road continually, and thus the best information available on the condition of the road typically comes from users who travel regularly on the road. However, the information obtained in this manner is often biased and inaccurate.

Figure 1. Grading a forestry road.

Various devices are currently available for accurately measuring the condition of the road, but they have been designed primarily for use on paved roads and are very expensive. To meet the unique needs of managers responsible for the maintenance of gravel roads, FERIC developed the *Opti-Grade* system. This system uses advanced technology to obtain accurate, unbiased, and inexpensive information on the road's condition; this is possible because users of the road collect the information during the normal course of their work. *Opti-Grade* measures the condition of the road and determines where

grading is required. By efficiently targeting grading interventions on the high-priority sites, the quantity of grading that is required can be reduced. It thus becomes possible to reduce the number hours of work required of the graders or to increase their range. This approach can also improve the comfort of users of the road and the road's long-term performance, as well as rapidly identifying problem sections of the road network. Maintenance of the roads only when required, on a variable schedule generated by *Opti-Grade,* ensures that graders work only where grading serves some purpose.

## The *Opti-Grade* system

*Opti-Grade* (Figure 2) is a grading-management tool that permits automatic data collection on road conditions. The system's operation is simple: a device for measuring road roughness mounted on the front axle of a vehicle (e.g., a haul truck) is linked to a data-acquisition system that records the level of roughness of the road and combines this with location data obtained by a global positioning system (GPS) receiver. The data collection thus imposes no additional costs and does not require the use of a dedicated vehicle, thereby making it possible to learn where the road has deteriorated and the magnitude of the deterioration.

When the truck stops at the mill's scale, the driver turns in a memory card that contains the data collected by the system. (An automated system is currently being developed.) The data are then transferred to a computer for processing by software that rapidly produces a grading schedule. Despite this high degree of automation, *Opti-Grade* leaves full control in the manager's hands because the software lets managers specify acceptable roughness levels as well as the recommended grading methods for each operation. On the screen, users can see the overall state of the road at a glance (Figure 3) and can ask the software to generate a corresponding grading schedule (Figure 4).

In addition to providing daily grading schedules, the software offers a series of reports on travel speeds, cycle times, and time spent with the vehicle travelling slower than a specified speed. These data, combined with the data on road conditions, can become an important planning tool during the negotiation of haul and road maintenance contracts. The reports can be displayed in the form of a table, a graph, or a map. Data gathered over the course of a haul season can also be used to identify which road sections are deteriorating most rapidly. Thus, the system provides a useful decision-support tool for planning rehabilitation interventions such as adding a layer of crushed rock or modifying the geometry of problem segments.

Figure 2. The components of the *Opti-Grade* system.

## Implementation

The system has been commercially available since 2001. During the first year, 18 systems were put to work across Canada, from Quebec to British Colombia. Monitoring of these systems revealed the main targets for operational use of *Opti-Grade*:

- Reduce the number of hours of grading while keeping the road in good condition.
- Continue with the same number of hours of grading, but improve the road's condition.
- Increase the grader's range.
- Use the time freed up by optimal grading to work on secondary roads.

**Forest Engineering Research Institute of Canada (FERIC)**

Find us online! www.feric.ca

**Eastern Division and Head Office**
580 boul. St-Jean
Pointe-Claire, QC, H9R 3J9
(514) 694–1140
(514) 694–4351
admin@mtl.feric.ca

**Western Division**
2601 East Mall
Vancouver, BC, V6T 1Z4
(604) 228–1555
(604) 228–0999
admin@vcr.feric.ca

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Each forestry operation can adapt the system to meet its specific needs. Figure 5 presents the potential annual savings with *Opti-Grade* as a function of the percentage reduction in the number of hours of grading and the number of graders deployed. The potential savings are considerable, since regular users of the system have reported reductions in their grading costs on the order of 25 to 30%. The following sections provide examples of current applications that reveal the advantages, flexibility, and potential of *Opti-Grade*.

## Example 1. Reduced maintenance costs

To reduce grading costs, one forestry company reduced its fleet of graders from three to two. To ensure that this cost-reduction measure would be acceptable to the road's users, the managers withdrew the third grader and began using *Opti-Grade* to manage the two remaining graders. The road's condition remained unchanged, despite using one less grader. Following the grading schedules produced by *Opti-Grade* thus permitted an effective 33% reduction in grader hours while keeping the road in good condition. In addition, the managers appreciated the availability of reports on vehicle travel speeds that were gathered by the system. They use this data to verify cycle times and monitor the average travel speeds on various sections of the road. The software was also used to verify vehicle speed while approaching stream crossings, where truckers must slow down to avoid damaging the bridges. Last but not least, the grading schedule let managers limit maintenance to sections that really required grading; this reduces the risk of diminishing the effect of any dust suppressants that have been applied by avoiding unnecessary disturbance of the road surface during the summer.

## Example 2. Increased scope of action for the graders

Another user faced increasing haul and maintenance costs because of ongoing expansion of their main road. This road has now reached a length of 180 km, and sustains heavy traffic; thus, the managers

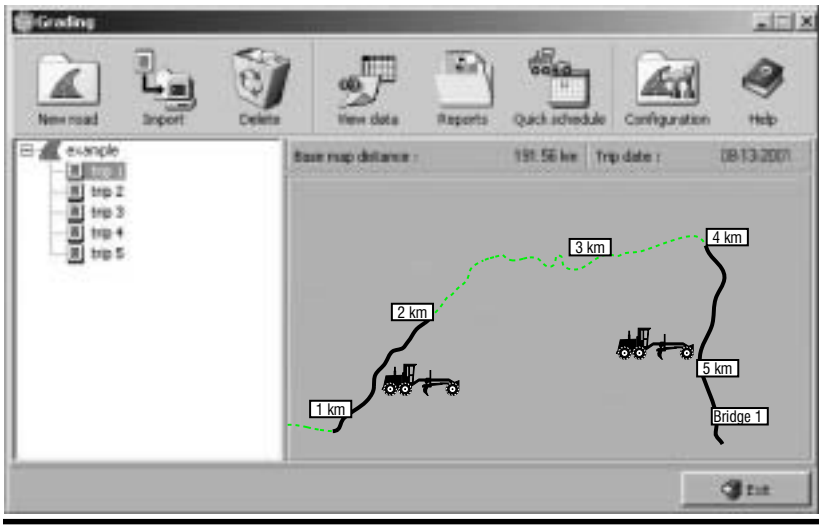
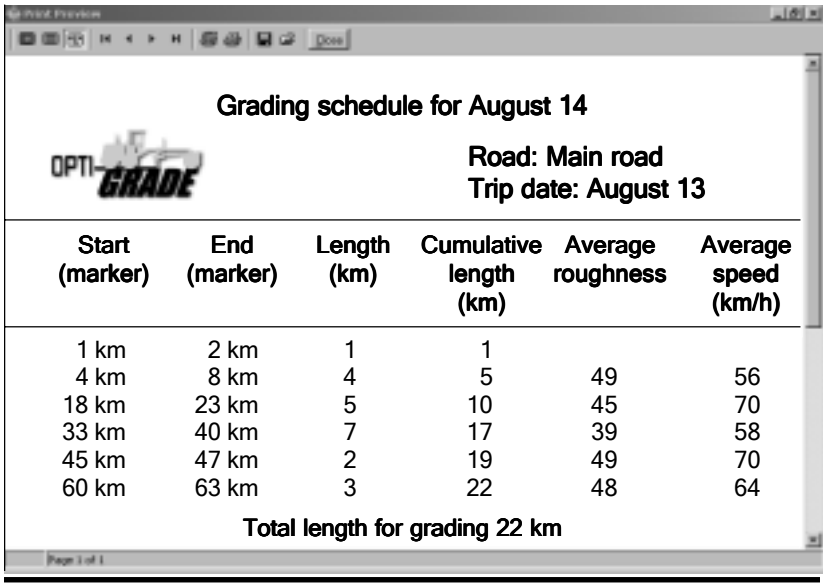



Figure 3. Report on road conditions generated by the *Opti-Grade* software.



**Grading schedule for August 14**

OPTI-GRADE

**Road: Main road**
**Trip date: August 13**

| Start (marker) | End (marker) | Length (km) | Cumulative length (km) | Average roughness | Average speed (km/h) |
|---|---|---|---|---|---|
| 1 km | 2 km | 1 | 1 | | |
| 4 km | 8 km | 4 | 5 | 49 | 56 |
| 18 km | 23 km | 5 | 10 | 45 | 70 |
| 33 km | 40 km | 7 | 17 | 39 | 58 |
| 45 km | 47 km | 2 | 19 | 49 | 70 |
| 60 km | 63 km | 3 | 22 | 48 | 64 |

**Total length for grading 22 km**

Figure 4. Example of a grading schedule produced by *Opti-Grade*.

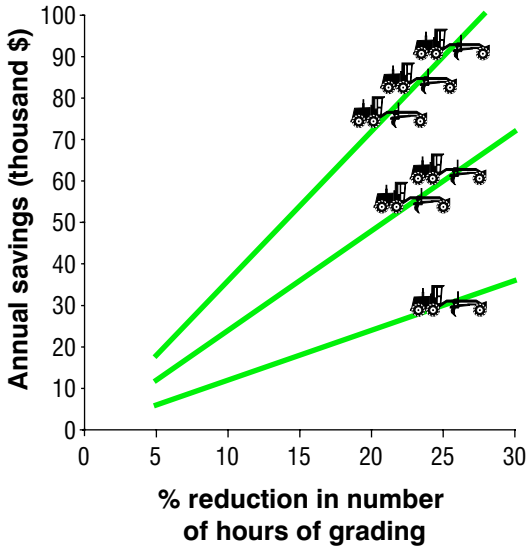



Figure 5. Potential annual savings from using the *Opti-Grade* system in relation to the number of graders deployed. (Savings are based on 120 days of grading per year, a direct operating cost of $100/hour, and 10 hours of work per day.)

expected that they would soon need to add a new grader. By following the grading schedules produced by *Opti-Grade,* a single grader was easily able to maintain 35 to 45 km/day rather than the 20 to 30 km/day that had formerly been achieved. In effect, this operation decreased its grading time by 25%, reducing the work week from 7 days to 5 days. The managers anticipate a better-quality rolling surface, which should translate into reduced haul costs as a result of this targeted management of road maintenance.

### Example 3. Improved effectiveness, quality, and user satisfaction

Using *Opti-Grade*, another company was able to maintain 210 km of main road and nearly 100 km of secondary road (roughly 300 km in total) using only two graders. According to the managers, better management of their graders on the main road let them free up this equipment to assist the crews responsible for maintenance of the secondary roads. In addition, *Opti-Grade* identified a 20-km section of the main road that required grading each day. This problem section was rehabilitated in the fall of that year. The managers were able to justify budgeting for the application of crushed rock because both the problem and the potential benefits of solving it could be documented using *Opti-Grade*. As well, the forestry workers reported that the road had never been in such good shape.

### Factors behind a successful implementation

It's important to emphasize that *Opti-Grade* requires some involvement on the part of roads managers to work well. The first days of any implementation can be difficult because the changes in grading practices can initially provoke protests from grader operators and users of the road. However, experience has shown that the condition of the roads quickly improves. The following factors increase the likelihood of a successful implementation of the *Opti-Grade* system:

- Managers should be interested in reducing grading costs or better investing their grading resources and must be involved in the implementation.
- Managers should have both the will and an opportunity to impose new work methods (e.g., existing contracts may hinder the implementation).
- Someone must be designated to take responsibility for daily monitoring of the system (5 to 15 minutes per day); alternatively, users can take advantage of a FERIC service that systematically provides grading schedules for managers (see the following section).
- The grading schedule must be communicated to grader operators.
- The grading schedules must be followed consistently.
- *Opti-Grade* was designed to manage a road network based on a main trunk road that receives daily traffic by the vehicle that carries the system. The system becomes economical when this main road reaches a length of around 75 km, though this varies depending on the usage conditions.
- *Opti-Grade* can also be used on spread-out road networks, but in this case, the vehicle on which *Opti-Grade* has been installed must still travel regularly over the entire road network for the company to benefit from the system.

### New service for users of *Opti-Grade*

Some users of *Opti-Grade* have expressed the desire to have someone else take over the task of producing grading reports and schedules. FERIC has thus begun offering a long-distance service for the transmission of grading schedules. Once the data have been gathered by the truck equipped with *Opti-Grade*, they are transferred to a terminal where they can be collected by FERIC. FERIC then analyzes the information and produces a grading schedule that is transmitted each morning to the grader operator. For more details on this service, please contact us.

## Reference

Provencher, Y.; Méthot, L. 1994. Controlling road surface conditions by management of grading. For. Eng. Res. Inst. Can. (FERIC), Pointe-Claire, Que. Technical Report TR-110. 9 p.