

## Evaluating Operator “Aptitude” using Simlog’s Hydraulic Excavator Personal Simulator

### Introduction

Here we describe the “Aptitude Test” developed by a heavy equipment operator training school to evaluate the operator potential of (unionized) employees in the Public Works department of a municipality, using Simlog’s Hydraulic Excavator Personal Simulator.

### About ENCEL

The École Nationale de Camionnage et Équipement Lourd (ENCEL) was founded in 1966 as the first private school in the Province of Quebec (Canada) to train commercial truck drivers according to Ministry of Education requirements. Soon after, a second training program for heavy equipment operators was added with similar accreditation.

In addition to these Ministry-approved programs, ENCEL also offers contract services to employers, both to help train new operators and to help existing operators improve their knowledge and skills.

With approximately 50 people on staff, ENCEL trains about 600 new truck drivers and heavy equipment operators every year at three campuses around the province: Quebec City (the original site); Terrebonne, as of 2005; Saint-Jean-sur-Richelieu, since January 2011.

### About Quebec City

Quebec City is the capital of the Province of Quebec. Founded in 1608 on the banks of the St. Lawrence River, the city recently celebrated its 400th anniversary as the cradle of French civilization in North America. It stretches out from the shores of the St. Lawrence, one of the largest rivers in the world, as far north as the foothills of the Laurentian Mountains.

Today, Quebec City is a major economic center with about 500,000 inhabitants living in six boroughs.

### The Operator Training Challenge

Every year, the city centre surveys its boroughs to evaluate the need for Public Works ser-

vices, taking into account the season and the size of the planned projects. In light of the heavy equipment available, the city determines the number of operators required for that equipment. Then by comparing that number with the number of operators currently employed (which changes from year to year as people retire, change jobs, move away, etc.), the city determines the number of new operators to be trained.

To address that training need, job openings are posted for people currently employed by the Public Works department. Interested employees must first obtain approval from their immediate supervisors before submitting applications. Decisions to allow employees to leave their current positions are based on union seniority.

But mastering the operation of heavy equipment requires human abilities which cannot be taught, just like a musical “ear”. For that reason, the city discovered that training new operators at the controls of city equipment was problematic, because many people were unable to develop sufficient operating skill. For that reason, the city decided to add “testing for operator potential” as a new requirement to the collective agreement signed in 2009 with the unionized staff in the Public Works department.

Practically, the city hoped to obtain the means to predict how well (or how poorly) a city employee could be trained to operate city equipment before any such training would begin (and before incurring any associated expenses). But how could that be done?

Thanks to the many years of experience using Simlog’s Hydraulic Excavator Personal Simulator for in-house operator training, ENCEL was confident that the same simulator could be successfully used to address Quebec City’s need.

### The Personal Simulator

The Hydraulic Excavator Personal Simulator at ENCEL consists of a real cabin with an operator chair fitted with two PC joysticks and Simlog’s Replica Controls pedal unit.



Marc Tremblay, shown seated in the cabin, is the ENCEL instructor responsible for the Aptitude Test.

The Simlog software is installed on a desktop PC located beside the cabin, and a video-projector mounted on the roof of the cabin provides a “life size” display on a projection screen (not shown in the images).

### **ENCEL’s Aptitude Test**

As developed by ENCEL, the Aptitude Test calls upon the candidate to use Simlog’s Hydraulic Excavator Personal Simulator in two stages. (When the candidate arrives at ENCEL, he must first present photo identification, such as a provincial driver’s license.)

For the first stage of the test, the ENCEL instructor sits with the candidate at the simulator to review various Simulation Modules. For each one, the candidate then performs a certain number of “trials” (exercises). The duration of this first stage of the test is about 1 hour and fifteen minutes.

For the second stage of the test, the candidate revisits the previous Simulation Modules, in the same order and for each one, performs the same number of trials but without the help of the ENCEL instructor (or any simulator documentation). The duration of this second stage of the test is about 30 minutes.

The Simulation Modules used for the test, and the number of trials per module, were jointly established by ENCEL, Quebec City’s Human Resources staff, and union management from the Public Works department. The goals were to maintain the interest of the candidate during the test, and to minimize repeti-

tion. (Of course, when training people instead of testing them for operator aptitude, repetition is not only desirable but essential.)

The same group also established the relative weights assigned to the Performance Indicators associated with each Simulation Module. For example, it was decided that “Execution Time”, a measure of job productivity, would have less importance than “Number of collisions”, a measure of job safety. Indeed, it was further decided that Number of collisions should always be zero, regardless of the simulated circumstances. Finally, although the simulation results include average, minimum, and maximum values for the Performance Indicators, it was decided that just the average values would be subject to evaluation.

Before the simulator-based Aptitude Test begins, the ENCEL instructor first administers a written test to evaluate reading comprehension. Since the duration of the written test is about 15 minutes, each Quebec City employee spends about two hours in total. Practically, he is paid for his time spent at ENCEL, along with travel time to/from city offices.

### **Evaluating Operator Potential using Simulation Results**

The candidate’s evaluation begins when the ENCEL instructor prints out the simulation results for the first and second stages of the test.

Because a candidate might already have experience operating heavy equipment (perhaps because of work at some previous employer), the ENCEL instructor looks for relative improvement from the first stage to the second, instead of just evaluating the “terminal” simulation results for the second stage.

Where a candidate had previous experience operating a backhoe-loader, the ENCEL instructor configures the simulator controls for the SAE (excavator) joystick pattern. Alternatively, where a candidate had previous experience operating an excavator, then the ENCEL instructor configures the simulator controls for the Backhoe-Loader joystick pattern. In this way, candidates is always obliged to use a “new” control interface in order to focus the test on evaluating the ability to learn instead of previously acquired skills.

Moreover, the test also evaluates the candidate’s ability to listen carefully to the help provided by the ENCEL instructor (during the first stage) and the ability to remember instructions (during the second stage). Throughout, the ability to concentrate e.g. to

avoid collisions, is also (indirectly) measured.

Where the simulation results for the second stage are noticeably better than the simulation results for the first stage, the candidate's score is "Success".

Where there is little or no improvement, the candidate's score is "Success with some reservations". In such cases, the employee is obliged to pass three other tests administered by the city.

Finally, where the simulation results for the second stage are poorer than for the first stage, the candidate's score is "Failure". In such cases, the employee may choose to be tested one more time but only one year later. By postponing the timing of the second test in this way, it is hoped that the employee will be able to resolve any personal or professional problems that might have contributed to "Failure" for the first test.

During the evaluation, the ENCEL instructor adds comments, as required, to provide a more complete picture. Here are some examples in the case of "Failure": "was learning very slowly", "was having problems remembering instructions", "was performing the simulated work poorly".

To date, the same ENCEL instructor has evaluated all city employees.

## The Pilot Project

After reviewing various alternatives, Quebec City selected ENCEL's Aptitude Test but decided to conduct a pilot project to validate the proposed approach in the Fall of 2009.

About thirty employees were selected from the Public Works department as follows: (a) people already working as equipment operators, (b) people who, in the past, could not be properly trained, and (c) people who expressed interest in becoming an equipment operator.

In this way, the city was expecting to see that employees in Group (a) would have "Success" scores, while employees in Group (b) would have "Failure" scores.

Proceeding "blind" without this knowledge, ENCEL's Aptitude Test performed exactly as expected. Indeed, the ENCEL instructor even determined whether employees were right or left handed!

## The Evaluation Continues

Upon the successful completion of the Pilot Project,

ENCEL was awarded two follow-on contracts to evaluate one group of 300 city employees in 2010-2011, and then another group of 300 city employees in 2012-2013, for a total of 600 city employees in all (not counting the thirty participants in the Pilot Project).

With some 1,500 employees in the Public Works department, the Aptitude Test will be targeting about 40% of the target population when the second contract comes to an end.

## About the Relative Distribution of Scores

Although the Pilot Project validated the merits of ENCEL's Aptitude Test, another question could be asked as follows: Is testing worthwhile? Stated differently, if the proportion of employees with scores "Success with some reservations" or "Failure" is small, why bother testing at all?

Here we answer that question by presenting the relative distribution of the Aptitude Test scores.

Score	Percentage
Success	75 %
Success with some reservations	20 %
Failure	5 %

In other words, about 75% of the city employees evaluated to date demonstrated real potential.

And since training at the controls of real equipment is so expensive, identifying the 25% with little or no potential before training begins has led to significant cost savings at Quebec City.

Indeed, research previously conducted by Simlog in collaboration with other customers has let us establish the following "rule of thumb": in any group of ten people, two or three are typically identified as having insufficient operator potential, thanks to simulator-based evaluation.

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