Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
CPU Hardware limitations (MHz)	500	100	No
Data accuracy (% correct)	82	99.9	No
Response time (seconds / query)	350	15	No

After commencing the project, the Appellant encountered a number of challenges in Belize, including poor telecommunication infrastructure. As a result of these challenges, the Appellant was unable to utilize its Electronic Health Record (“EHR”) solution to address the project’s goals, primarily because of the inability of the limited infrastructure in Belize to support this EHR technology. Consequently, the Appellant was unable to link the various health institutions, including health care centres, rural clinics, labs and pharmacies for the comprehensive exchange of data, as required pursuant to the terms of the project contract.

The approach to even the simplest component of detecting when connectivity existed had to change. The challenge was one of providing equal access to predictable data integrity where connectivity issues ran far deeper than would be encountered in a stable and secure environment such as Canada.

Field of Science/Technology:

Computer sciences (1.02.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility
Key Employees:	
Evidence types:	Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Initially, the Appellant attempted to duplicate the target environment conditions of Belize in the laboratory, focusing on the correct operation of replication algorithms, without the burden of network problems, in order to isolate potential defects in the algorithms. Transitioning of the replication algorithms to the conditions of the target environment required the algorithms to be more fault-tolerant in an attempt for the system to seize the advantage of connectivity when it was available.

DEPARTURES FROM PRIOR ART:

The company testified that the technological challenges were not reasonably predictable of resolution using standard procedures or routine engineering. The Appellant searched unsuccessfully for an existing “off-the-shelf” replication software system.

The replication solutions that were available in the field at the time did not suit the required objectives of the Appellant for this project. The most commonly-used replication solution was a system of master/slave replication. This solution permitted changes on the master database only while replicating or mirroring those changes to the slave databases. However, the Belize project required replication technology that would support changes to any database with those changes being exchanged asynchronously because of the connectivity issues.

As Mr. Rutter explained:
The master doesn’t know that the node has connection. And the node doesn’t know if the master has a connection. So, they’ve got to act independently or asynchronously – asynchronously to move the data.

It formulated a plan to develop a multi-write database where each ‘node’ (of which Belize had more than fifty) could write to the main file. The replication systems that were available were intended for different purposes and were not appropriate to achieving the Belize project goals. Those existing replication systems did not account for the nature of the severe underlying network problems.

The most significant underlying key variables are:

node and master behaviour, sequence & subscription strategies (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	see Google articles in Prior art list
Patent searches	10 patents	see patent links in Prior Art list

Activity #1-1: Activity 1 (Fiscal Year 2015)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	854 alternatives
Trials:	1400 runs / samples
Other methods:	140000 lines of prototype code

Due to the unprecedented technological problems, the Appellant “undertook experimental development to attempt to create technology that could mimic the availability of stable communications infrastructure in a hostile network environment where nodes must optimize the utilization of the minimal network resources.”

The claimant provided a SR&ED activity sample that elaborated on the systematic investigative process that occurred with respect to a particular task, of observing and analyzing replication functionality over dial-up, which was part of the larger project.

This was meant to serve as an example of one experiment of many project elements that took place over a three-week period. The document outlined the objectives, procedures, observations conducted and investigative techniques that were pursued and utilized in respect to this one element. These various documents showed how the project evolved in respect to developing hypotheses, conducting various testing of theories, installing and refining algorithms and evaluating the outcome.

They did not “measure these connectivity issues”, except through observation and experience, because they had no control over the private company in Belize that was in charge of connectivity in that country. This measurement related more to the integrity of the data and the accuracy with which it reached its destination despite connectivity challenges.

He referred to the content of these notes, which list “rough algorithms” for network behaviour, the three stages of full synchronization using the mobile connector, the operative requirements of the node manager in order for it to manage sequences and subscriptions, and node and master behaviour.

TYPES OF DOCUMENTATION MAINTAINED

Mr. Kilburn testified that he kept notes, whiteboard photos and computer script notes, which were completed contemporaneously with the planned testing being conducted.

In conducting test cases, some of them were embedded in the software through unit tests, while others were developed through “idea development” from initial brainstorming to prototyping design of the various aspects of the health information system that had to be integrated within an environment of unreliable network connectivity.

Unit tests and staging tests led to algorithms that could be refined and installed to try to simulate and validate theories based on available connectivity.

Mr. Kilburn testified that logs, or notebooks of the software, tracked events and if there were errors or connectivity issues, an analysis of the logs was conducted. The code was modified to address the problems so that eventually, based on the anticipated environment, the code would behave as expected at every facility in Belize.

In addition to constructing algorithms that would synchronize data across a multi-write network and ensure that patient data had complete availability and correctness.

Results:

Conclusion:

Taxpayer Wins - Based on the facts & issues analysed the judge concluded that;

"Although the documentation was not as detailed as I would like to see, particularly with respect to the types of tests performed and the results achieved, I am satisfied with the oral testimony of the Appellant's witnesses. For the most part, their evidence was not challenged on cross-examination and Mr. Rutter, Mr. Kilburn and Mr. Bearisto provided credible explanations respecting the scientific investigation and method they adopted in order to develop the HIS."

The solution to the technological uncertainties that existed with the Belize project resulted in the creation of a multi-write database replication system. This approach was not only innovative but leading-edge in that it produced an integrated health information system that resulted in the successful establishment in Belize of the first nationwide health information system of its kind.

The evidence suggested that the available open source replication solutions were inappropriate as they were meant for very different purposes within the field, designed to work with strong connectivity infrastructure. Since an appropriate replication solution was not available, the Appellant undertook experimental development work to create technology that could mimic a stable communications infrastructure in the hostile environment that existed in Belize.

LONG TERM SIGNIFICANCE (moderate):
DESPITE THE FACT THAT THE TAXPAYER WON THE CASE, THE FACTS PROVIDE LITTLE IN THE WAY OF SPECIFIC HYPOTHESES OR TECHNOLOGICAL ADVANCEMENTS. AS A RESULT IT IS LIKELY OF MODERATE LONG TERM SIGNIFICANCE.

Significant variables addressed: node and master behaviour

Documentation:

Offline Documents: journals, whiteboards & computer scripts

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Turbine power increase (%)	100	240	No

[5] By reassessing the Appellant's tax payable for the 2011 taxation year, the Minister made the following assumptions of fact, listed in subsection 11 of the Reply to the Amended Notice of Appeal:
a) [TRANSLATION]
The Appellant works primarily in the sale and development of new mechanical concepts for manufacturers or prospective license buyers;
b) The Appellant operated under the name Les Moteurs Novalia 2000 Inc. until March 15, 2011;
c) The Appellant is a "Canadian-controlled private corporation" under the Act;
i) Normand Beaudoin filed a patent application for a "Turbine energy windmill" on August 19, 2011 (CA 2750048); however, the patent was not issued until April 24, 2013;

Minister made the following assertions of facts:

j) With respect to project no. 1, entitled "Turbine energy windmill" (project no. 1):
i) The goal was to increase turbine windmill power and make all of its components ergonomically cost-effective with the following features:
A. Less cumbersome;
B. Blade width will be equal to that of its extremities, which will increase wind surface area;
C. Blades will exert a positive force that will be evenly distributed amongst all components.
ii) The Appellant submitted secondary objectives for potential commercial applications (vacuums, propellers/pumps), without demonstrating any related activities;

vi) The Appellant did not define, from the outset, the performance indicators or measures to be carried out to meet its primary objective. These measures are a standard part of a systematic investigation process;

Field of Science/Technology:

Applied mathematics (1.01.02)

Project Details:

Intended Results:	Improve existing processes, Improve existing materials, devices, or products
Work locations:	Research Facility
Key Employees:	Normand Beaudoin (Music - PhD (1980) / President)
Evidence types:	Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Photographs and videos

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

iii) The Appellant evaluated existing wind power concepts and devised a drive engine with pulleys and rectangular blades, without taking into account any concepts related to fluid dynamics, modelling, natural phenomena or laws that could enter into play.

iv) The technology base or level for project no. 1 can be compared to that of wind turbines, which are a cross between a windmill and a turbine;

v) The Appellant indicates that it would like to increase wind turbine power in an ergonomically cost-effective manner, but does not list or describe the parameters in question;

The most significant underlying key variables are:

blade shapes & orientations (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Patent searches	11 patents	patent granted US- 11 patents + referenced by 8 since https://www.google.com/patents/US20130202435?cl=en

Activity #1-1: Activity 1 (Fiscal Year 2017)

Methods of experimentation:

vii) The Appellant evaluated existing wind turbine concepts;

viii) The Appellant developed a mechanism (pulleys and rectangular blades, belts) to interest future investors, but failed to create models or take validation measures, natural phenomena or laws into account that could enter into play (fluid dynamics, among other things).

ix) The Appellant presented real-time calculations prepared by a third party comparing a rectangular turbine to a circular turbine; however, these were not corroborated, were based on static conditions and did not include actual dynamic parameters;

x) The calculations submitted by the Appellant (prepared by a third party with no corroboration) present a theoretical efficiency of 240% with no scientific basis or corroboration over time;

xi) The Appellant constructed a mechanism (bicycle base / blades / parallel belts / fittings with criss-cross supports) based on current engineering practices;

[18] According to the CRA professional witness (Mr. Haine, ____ Designation not disclosed)"

[19] Mr. Beaudoin did not contest Mr. Haine’s status as an expert, but naturally disagreed with the conclusions of the report. In his opinion, the quality of the report cannot be relied upon because Mr. Haine refused to consider previous machines or wind turbines constructed later and, thereby, the general scientific advancement, by focusing solely on the specific technology, the scientific basis of which he called into question. Mr. Beaudoin’s theory on the scientific advancement is as follows:

[TRANSLATION]
It is not the drive wheels or the belts that provide the scientific basis for the advancement; rather, it is the fact that the drive wheels increase rotation speed and that the belts play a key role similar to the effect of the connecting rod in a piston engine or a counter-rotational cylinder in a turbine engine, which free the blades from strict axis rotation, and synchronizes them with the fluid flow.:

None of the activities (experiments or analyses) demonstrated whether or not this objective was achieved. When it is a question of aerodynamics, which is the case with wind turbines, standard experimentation can only be performed in a wind tunnel (more controlled environment). If Mr. Beaudoin could only demonstrate the validity of his idea through visual effects, we would expect to see two devices (one conventional and one based on the new concept) tested under the same conditions to be able to observe the difference. In the end, we do not know what the device was used for other than to move air, as all other wind turbines do, only in a more complicated manner. Moreover, no mathematical models of the natural phenomena at play were created.

In conclusion, I am of the opinion that the goal of the work performed was not to resolve any scientific or technological uncertainty. Rather, it illustrated an idea that was based on an erroneous understanding of the phenomena that characterize wind turbine movement. Mr. Beaudoin’s explanations did not help me to understand how the device he built could lead to any kind of advancement in wind turbine power or increase in the knowledge of the technology in question. Mr. Beaudoin may have had a few good ideas for the design and construction of the device itself (presented in the video); however, that is not enough to demonstrate the scientific or technological advancement he claims in his application.

[19] Mr. Beaudoin did not contest Mr. Haine’s status as an expert, but naturally disagreed with the conclusions of the report.

In his opinion, the quality of the report cannot be relied upon because Mr. Haine refused to consider previous machines or wind turbines constructed later and, thereby, the general scientific advancement, by focusing solely on the specific technology, the scientific basis of which he called into question. Mr. Beaudoin's theory on the scientific advancement is as follows:

[TRANSLATION]
It is not the drive wheels or the belts that provide the scientific basis for the advancement; rather, it is the fact that the drive wheels increase rotation speed and that the belts play a key role similar to the effect of the connecting rod in a piston engine or a counter-rotational cylinder in a turbine engine, which free the blades from strict axis rotation, and synchronizes them with the fluid flow.

[20] According to Mr. Beaudoin, the advantage to synchronizing the blades with the fluid flow is that it reduces the machines' loss of efficiency because their rotational motion is unitary and too slow, making the connecting rod less effective.

Results:

xii) The Appellant's mechanism creates mechanical friction that reduces the efficiency rating of 240%;
xiii) The Appellant tested the mechanism (vertical and horizontal positions) and experienced issues with it that reduced the efficiency rating of 240%;
xiv) The Appellant did not purchase any materials for project no. 1, even though it indicated that it had tested the mechanism;
xv) The Appellant tests its mechanisms using a trial and error system;
xvi) The Appellant's work involved a pre-feasibility study for a potential project and did not explore beyond current practices;

Conclusion:

The CRA contended that the goal of the work performed was not to resolve any scientific or technological uncertainty. Rather, it illustrated an idea that was based on an erroneous understanding of the phenomena that characterize wind turbine movement.

According to the Judge:

[25] It is important to reiterate here that the Appellant's research project has been examined by three CRA scientists, one of whom is considered an expert, and that Mr. Beaudoin has had many opportunities to explain his point of view and convince them that his research activities meet the requirements of the Act.

According to the CRA's scientists, the Appellant's research project never reached the SR&ED stage because it simply involves a concept illustrated by drawings and demonstrated using an extremely rudimentary prototype, at least in the 2011 version of the project.

[26] If we apply the criteria set out by Bowman J. in Northwest Hydraulic Consultants Ltd. v. The Queen, cited above, to determine whether the Appellant's research activities qualify as SR&ED, it is clear that none of the five criteria therein are met in this case. There is a lack of both uncertainty and technological advancement; no clear hypothesis was formulated or technological investigation performed as part of the scientific method used; and, lastly, the hypotheses, tests performed and results obtained were not properly recorded as the project progressed.

[27] In conclusion, the work performed by the Appellant does NOT constitute SR&ED within the meaning of subsection 248(1) of the Act,

Documentation:

Uploaded to RDBASE.NET: 2016_TCC_81 Novalia Advancement Wind Turbines LOSS.pdf (141KB)

Offline Documents: Prototype (covered in snow), Videos of prototypes

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Arterial plaque reduction (%)	100	95	Yes
Replace intravenous with oral (Yes 1/ No 0)	0	1	Yes

[34] Project 3 is a natural health product to remove arterial plaque. Dr. Dahl hypothesized he could create an oral chelatory form that would deal with chelation (binding) to take the arterial plaque from the blood vessels, to vasodilate the blood vessels to increase circulation to the extremities, and to take the plaque off the organic material from the brain stem. EDTA was being used in intravenous form for this purpose. Dr. Dahl believed that, if EDTA were instead used in oral form with complementary ingredients to accomplish the same thing, it could be available over the counter for home use and would lessen damage to other organs such as the liver and pancreas.

[36] Dr. Dahl wished to use EDTA in a manner that was complementary with other ingredients. He understood Health Canada would not allow EDTA as a medicinal ingredient. Health Canada would, at some later time, permit it to be added as a supportive non-medicinal ingredient. Dr. Dahl studied the research and methodology of a German doctor and read studies from that doctor's institute. Dr. Dahl analyzed his research on the German studies. He described his "real activities" as isolating the two components he was going to use and then formulating a final product within his mind and on paper, while also incorporating other selected ingredients that would not compete with the two ingredients needed for the chelation process itself.

Field of Science/Technology:

Nutrition & dietetics (3.03.02)

Project Details:

Intended Results:	Develop new materials, devices, or products
Work locations:	Commercial Facility
Key Employees:	Eldon Dahl (Naturopathy - PhD (2000) / President Lifesource)
Evidence types:	Records of resources allocated to the project, time sheets

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[35] Dr. Dahl had studied the matter for several years; he did systematic reviews on what makes up the blockage in arteries. The blockage was known to be caused by inorganic material, including heavy metals forming within the blood vessels and the brain. It was his belief that EDTA being administered by medical doctors intravenously was not complete and could further impact other areas of the body.

[37] Dr. Dahl said he knew certain chelating ingredients but he realized through further study that some were antagonistic to each other. Therefore he said he decided through hypothesis which would be the most effective. He said he originally wanted to choose between EDTA and DMSA, but Health Canada would not allow the use of DMSA as a medicinal ingredient in over-the-counter products. So he then set out to create a formulation with the EDTA that would not be toxic to the body.

[41] Dr. Dahl said he had undertaken lots of literature review before beginning his third project. He had studied the subject immensely. He referred again to his fascination with another doctor's work, findings, results and discoveries. He consulted several articles and had one translated from German.

[46] I am prepared to accept that there was scientific uncertainty in each of the three Projects. There was uncertainty that natural health products could be effective in mimicking the existing pharmaceuticals in use. There was uncertainty as to whether other supplemental complementary natural ingredients could minimize adverse effects of the principal new mimicking natural ingredients in an effective manner. Once the Projects were reformulated to use the existing

pharmaceutical instead of a mimicking ingredient, as in Projects 2 and 3 described above, there remained the uncertainty of identifying supplemental complementary natural ingredients that would be effective in lessening or removing adverse side effects of the existing chemical ingredients.

The most significant underlying key variables are:

antagonistic effects of ingredients (unresolved), EDTA vs DMSA (unresolved), effects of chelation process (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	36 Articles	Dozens of articles references
Suppliers	8 products	Performed analysis, studies; incorporating the use of outside sources like Dicentra, the -- my raw material supplier who has his master’s degree as a pharmacist.
Queries to experts	5 responses	cited consulting with several naturopathic doctors

Activity #1-1: Activity 1 (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives

[40] Dr. Dahl stated that “[my original formulation, once effective, would achieve the desired results,” However, once acetyl-L-carnitine was taken off the restricted schedule by Health Canada and could be used in over-the-counter formulations, as described above, Dr. Dahl reformulated Project 3 as well to incorporate that ingredient in lieu of EDTA which was not allowed to be used as a medicinal ingredient. Acetyl-L-carnitine is also a vasodilator. So he analyzed existing documentation he had and checked for compatibility. He described acetyl-L-carnitine coming off Health Canada’s restricted schedule as a godsend since he knew clinical studies, especially those by another particular doctor, and he had used it on patients for 20-plus years. He knew it would accelerate the effectiveness.

[42] At the end of his examination-in-chief, counsel for the Appellant asked Dr. Dahl to evaluate his time spent on all three Projects. He answered as follows:
Well, it’s -- my review is commensurate with my work that I perform due to analysis, studies; incorporating the use of outside sources like Dicentra, the -- my raw material supplier who has his master’s degree as a pharmacist; consulting with several naturopathic doctors; and my staff who help me do the research and do some of the leg work.

[43] At the end of his testimony, I asked Dr. Dahl to please clarify what he meant when he used the phrase systemic review or systematic review. Specifically, I asked what it was he systematically reviewed and how he performed that systematic review. He answered that he did a systematic review of the analysis he had extracted of the clinical studies of others by completing a literature review and correspondence and dialogue with other authorities such as naturopaths, professors and pharmacists. He added that he did additional analysis by evaluating the calculation of the ingredients in his formulations by drawing on his accumulated knowledge and expertise and then submitting his formulations to Health Canada for licensing. He said he did not have clinical trials done because of the expense; he had earlier testified that clinical trials were not needed for natural health product licensing by Health Canada. He said his testing of his hypotheses was based upon evidence he received from other authorities like the World Health Organization.

He said his formulations were “tested through hypothesis and in evaluation based on evidence”. It was clear from his earlier testimony this was pre-existing evidence of others and his own accumulated knowledge and clinical observations. He described his final testing, short of clinical trials, was to submit his formulations to Health Canada for approval which, once obtained, deems the formulations to be effective.

[44] Dr. Dahl was even more clear and succinct when then asked by counsel for the Appellant what scientific analysis or work was done. Dr. Dahl said he first evaluated the condition that was to be treated. Secondly, he reviewed the human body concerning the diseased state and produced a formulation to address that condition. His analysis was done using clinical evidence from a review of authoritative scientific studies. He used this combined research to formulate a unique product that would address these authorities analyzed as part of his literature review.

[45] Dr. Dahl's answers were consistent with paragraph 29 of Life Choice's notice of appeal: "The Plaintiff asserts that the formulas were developed in a scientific manner, requiring analysis of available information collected from existing literature, suppliers, regulatory bodies and analysis of ingredients."

Results:

- Arterial plaque reduction: 98 % (40% of goal)
- Replace intravenous with oral: 0 Yes 1/ No 0 (no improvement)

[50] It is the absolute absence of testing of the natural health products by Life Choice after their formulations were hypothesized by Dr. Dahl that is fatal to this appeal. It is a clear conclusion from the evidence that, not only was no such testing done, neither Life Choice or Dr. Dahl ever intended to do any as part of these Projects. The jurisprudence has clearly, consistently and correctly interpreted the definition of SR&ED as requiring some form of testing of the hypotheses developed in order for there to be systematic investigation or search carried out by means of experiment or analysis. Question 2 of Northwest Hydraulic, above, in point 5 of its five-step process requires consideration of whether there was methodical and systematic testing of the hypotheses. Question 3 of Northwest Hydraulic requires consideration of testing as an included step in the scientific method. Question 5 requires consideration of whether records of the testing of the hypotheses and those results were maintained as the work progressed.

Conclusion:

[52] It is not the absence of clinical testing that is fatal to Life Choice's appeal. It is the absence of testing in any form or fashion that could be said to have been performed in a systematic fashion. Systematic testing for any or improved effectiveness of Life Choice's formulations could have been done by Life Choice and could have been performed to assess, verify, statistically infer, or gauge effectiveness without full-blown clinical trials sufficient to satisfy Health Canada if the products were restricted pharmaceutical products, which they were not. Any such testing could have been performed in a manner that met the requirements of the SR&ED definition even though it would not have satisfied a Health Canada requirement, or if, as in this case, there was no Health

[53] My decision in this case is in no way intended to suggest that literature reviews and consultations with other researchers cannot be qualifying activities giving rise to qualifying expenses as legitimate constituent parts of SR&ED activities. This appears to be clear from a fair, liberal and purposive reading of the SR&ED definition, including paragraph (d) thereof, and from former Chief Justice Bowman's comments on the role of intuition, creativity and sometimes genius in Northwest Hydraulic, above. Nor is this decision intended to suggest that a person performing SR&ED cannot use the data or results of the completed research of others in developing and/or testing their own hypotheses or theories.

[54] Having found that there was no testing by Life Choice of any of its formulations or reformulations after they were hypothesized by Dr. Dahl, much less testing performed in any systematic fashion, the appeal must be dismissed

Documentation:

- Uploaded to RDBASE.NET: 2017_TCC_21 Lifechoice Systematic Investiation LOSS.pdf (392KB)

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Thickness (mm)	7	4	No
Steaming time to activate (min)	120	60	Yes
Open time (days)	30	60	Yes
Cost ($/m)	80	65	Yes
Diameter range (cm)	15	15	Yes
Weight (kg/m)	3	2.6	Yes
Stress resistance (kg/mm)	5	11	Yes
Disposable mandrel (yes = 1 / no = 0)	0	1	Yes
Access points for mandrel (number)	2	1	Yes

This project is based on the ruling case is based on the Tax Court of Canada Ruling for Formadrain Dossier: 2016 1658 (IT) I

[2] The appellant operates a company engaged in the development of technologies for the rehabilitation, without excavation, of underground conduits and industrial process conduits. Formadrain sells its technology in Canada and the United States.

[3] Established in 1994, the appellant initially developed a system that involves firing a pre impregnated fiberglass and epoxy sheath into an existing pipe through existing accesses to repair underground conduits without excavating. In other words, a new pipe is made inside the old one, without digging [1].

[4] To do this, the underground ducts are sheathed with a system baked in place, better known under the English name "Cured in Place Pipe" [2] .

[5] In 2012, the appellant team is working on two projects that involve the development of products for which SR & ED ("investment tax credit") expenditures are claimed:

1) The development of a latent resin ("resin");

2) The development of equipment to facilitate the installation of the Formadrain sheath, ie a lightweight single use chuck ("mandrel") allowing installation in a single access instead of two.

[6] The context of these two projects is as follows. It is difficult for some clients of the appellant, either sewer repair contractors, to implement the appellant's technology. Often, sewer lines can reach up to 200 feet long. Small contractors lack the space required to uncoil the sheath and apply the resin solution to such a surface.

[7] The appellant decides to develop a turnkey technology. Thus, the sheath, including the mandrel, would be sold preimpregnated with resin. The appellant's clients, the contractors, would receive a product ready to repair a sewer.

[8] To achieve this objective, the appellant must develop a resin with an open time of 60 days and can be steamed in 60 minutes or less, regardless of soil conditions such as water and temperature Variables.

In 2012, the resin was only four hours long. To that end the appellant's external chemist told the appellant that she would not be able to develop a resin that would have an open time of 30 days and still less than 60 days.

[9] to develop a turnkey technology, in addition to the resin, the appellant also wanted to develop a new mandrel, a lightweight one use
chuck. This new mandrel would allow the appellant to repair the underground duct without digging and to do so by accessing it only through access, or the
"cleaner" inside the building rather than accessing the street either through The "manhole". In addition, a lightweight mandrel would allow it to be
pushed in place instead of being pulled.

[11] If the appellant succeeded in developing these two products that go hand in hand, this would make it possible to sell this turnkey technology.
Thus, the resin impregnated sheath having an open duration of 30 days to 60 days, including the new mandrel, would be transmitted to the client contractors.
The contractor would only have to make the repair.

[12] These projects began in 2010, but the technology was still not up to date in 2103. So during the 2012 and 2013 tax years, the appellant con nued
its research and development activities with respect to resin and mandrel One-time use.

[13] In 2013, a third project was added to its SR & ED actvities, namely, the development of equipment and a method to connect the service inlet
connection to the municipal main sewer, T mandrel

[71] Mr. Therrien indicated that the appellant did not have a detailed plan in advance. However, research and testing were always done according to their overall objective: to develop a single use chuck capable of responding to mechanical stress (pressure, heat, mechanical deformation) both at insertion and at extraction and able to mold different configurations Sewers.

Effectively the work involved developing a single-use light mandrel (tube) to install a sheath from inside the drains from a single access point from inside a building.

Standard devices used heavier nondisposable mandrels that required two points of access in order to pull rather than push it.

[28] The idea of repairing sewers without excavation matures for ten years, before Marc Aurèle decides in 1993 to associate with the engineering
firm Deblois Engineering, Île d'Orléans.

[29] At that time, the "no excavation" system was already in use at the city level, but the idea of transposing this system to residential sewers was
farfetched given the complexity of access to sewer and Changes in direction and changes in the diameter of these ducts.

[30] Mr. Therrien indicated that as of 1994, the appellant's team has engaged in research and development to develop functional technology. It
was no small task. In 1996 97, the technology was lame.

[30] However, gradually a manual containing the procedure was developed by the appellant in order to gain a better understanding of the
terrain and to better control the wide range of uncontrollable elements attached to it. The witness gave as an example the infiltration of water and
the dissipation of heat.

[32] However, it was only in 1998 that the appellant began to allow sewer repair contractors to use its technology through licensing throughout North America.

[33] The appellant is now a leader in the sewer repair industry without excavation. In addition, 36 licenses to use the technology developed by the appellant were awarded to entrepreneurs, including 6 in Quebec, 20 in the other provinces of Canada and 10 in the United States. [4]

[34] In 2012, the appellant had approximately 20 employees, including three engineers, and its turnover was in the order of $ 1.75 million.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility, Lab
Key Employees:	Stephane Therrien (Civil - PEng (1993) / President), Carl Marc-Aurèle (Chemical - PEng (1999) / VP)
Evidence types:	Records of resources allocated to the project, time sheets; Project records, laboratory notebooks; Design of experiments

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[85] The technological uncertainty was the fact that the chosen material must be thin, affordable and withstand mechanical stress to the insertion and extraction. In addition, the material must be flexible enough to mold configurations or changes in diameter and changes of direction up to 45 degrees and to adapt to the heat.

[86] In addition, the material must have a certain resistance to tearing as sewer repair are not smooth, they are often very rusty and it may be rough and tubers that are important. As M. Therrien has indicated, there is no doubt that the thin rubber existed on the market, but there was no thin rubber that can adapt to these constraints.

[24] Mr. Therrien has been employed by the appellant since 1994. He became a partner in 1999 and since September 30, 2016, he is the appellant's president. He succeeded Mr. Gérard Marc-Aurèle, the founder and former president of the appellant, who died in 2016.

[25] Mr. Therrien is a civil engineer. He testified about the research activities related to the development of the new lightweight chuck.

[26] Mr. Carl Marc-Aurèle is also employed by the appellant. He is Vice-President of the Appellant and is a Chemical Engineer. He testified about the development of the resin.

[27] The appellant was created in 1994 by Mr. Gérard Marc-Aurèle. Marcus Aurelius was not an engineer, but he had the soul of an inventor withan avant-garde vision.

The most significant underlying key variables are:

composition of form, chuck design, mandrel configurations & composition, push vs pull deployment, resin formulation (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	3 Articles	AUTHORS NOTE: THE IDEAL COURT DESCRIPTIONS WOULD PROVIDE DETAIL ON DUE DILIGENCE, COMPETITIVE & PRIOR ART ANALYSIS.
Similar prior in-house technologies	4 products / processes	proprietary in house process

Activity #1-1: Activity 1 (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	460 alternatives
Trials:	23 runs / samples
Physical prototypes:	8 samples

(1) 2012 project: development of a method / equipment to install the Formadrain duct by a single access instead of two accesses [7] .

[43] Trials conducted by the appellant during her 2012 tax year are recorded in a laboratory workbook, in a 62 page document submitted to the Court containing descriptions and photos. Mr. Therrien testified to the effect that the notes found there were always inscribed in a contemporary way.

[44] In 2012, the work was oriented towards the design of a mandrel:
- thinner;
- More flexible;
- lighter;
- Capable of resisting the stress caused by the installation of a sheath by push in place and by its extraction;
- Disposable, therefore at a lower cost than a reusable mandrel.

[45] Several tests were first made with a new nylon chuck, designed already full diameter, and that did not need stress to stretch.

[46] However, the deployment did not proceed uniformly throughout the trials. Some specific areas were not sheathed, and as a result they swelled prematurely and disproportionately.

[47] The appellant's team modified a number of parameters to counter the problems of sheath deployment due to breakage of the release agent. For example, it tried to change the swelling rate, use various types of lubricants to reduce friction, and coat the silicone chuck.

[48] For this purpose, the nylon mandrel has worked in the factory. The appellant then decided to conduct an "in situs" trial in the field. Therrien explained that the team is attempting to replicate field conditions in the field, however, it is very difficult to reproduce all the variables offered by the field trial. For the appellant, field trials are important and part of the experimental development. During these trials, only labor related costs were billed to customers, including equipment and time required for installation.

[55] As Therrien explained, thin rubber exists, however, in this case, the technological uncertainty was whether a thin rubber mandrel could withstand mechanical stress at insertion and extraction, if The rubber could mold different configurations, changes of direction up to 45 degrees and adapt to the heat.

In addition, the rubber must have some resistance to tearing since the sewers to be repaired are not smooth, they are often very rusty and there may be roughnesses and tubers which are important. Thus, the required rubber was not on the market.

[56] The appellant hired Pro Flex to produce the rubber tubes that would serve as its mandrels. Pro Flex is an expert in the manufacture of rubber products.

[57] Although the appellant is a research and development specialist, and Dr. Carl Marc Aurèle is a chemical engineer, the rubbers contain very complex chemical properties that exceeded the appellant's expertise.

Results:

- Steaming time to activate: 70 min (83% of goal)
- Open time : 62 days (106% of goal)
- Cost : 70 $/m (66% of goal)
- Diameter range: 15 cm (100% of goal)
- Weight: 3.1 kg/m (no improvement)
- Stress resistance: 9 kg/mm (66% of goal)
- Disposable mandrel: 1 yes = 1 / no = 0 (100% of goal)
- Access points for mandrel: 1 number (100% of goal)

(1) Was there a scientific or technological uncertainty?   The Judge commented:

[87] The respondent, for its part, has given much importance to the fact that the appellant had used Pro-Flex for developing the chemical formula of rubber that was used to manufacture the mandrel.

[88] The respondent argues that the source of technological uncertainty of this project lay entirely in the chemical composition of the material, a task that was delegated to a rubber manufacturer.

[89] I have difficulty with the argument of the respondent because paragraph d) of the definition of research and development in subsection 248 (1) of the Act includes the development activities in Canada directly undertaken on behalf of the taxpayer.

[95] In this case, the factors and parameters to be checked by calling for the development of disposable mandrel were located both in the material composition of the mandrel at the level of the method allowing it to push up from a single access.

[96] It seems that the entire project reduce the relative appellant mandrel unique aspect of the search for the chemical formulation of the rubber is a simplistic view of work that has actually been made.

[101] In this case, it is clear that the appellant did not know initially how it would develop and install a disposable mandrel by pushing it inside a pipe. Seen as a whole, the project included the appellant multiple technological uncertainties residing both in the chemical composition of the core, thickness and length, as mechanical stress that allowed it to be inserted and removed from the leads.

[102] Engineers working on the projects had several years of experience in the field of repair sewer without excavation. Considering the expertise and knowledge in this area, it is clear that the factory tests and "in situs" were made because of a real technological uncertainty.

115] At the end of 2012, the appellant made two field tests which were unsuccessful. However, research which it has engaged subsequently enabled him to understand the inflation mechanism and that it would be impossible to develop a mandrel in which there was already a diameter.

[116] In 2013, the technology was not yet developed, but it was better understood and better managed by the appellant. For example, the appellant returned to rubber after testing nylon and silicone. The appellant knew in light of the tests that rubber would work, since its current core work. However, the appellant had to use another rubber formulation being able to withstand the many constraints.

This thin rubber required for proper operation of the chuck did not exist on the market. To this effect, a rubber formulation satisfying all the criteria developed by the appellant had not been developed. The tests were all unsuccessful.

[117] At the hearing, M. Therrien stated that the appellant had now succeeded in developing a lightweight core using a thin rubber can be used for certain repairs by pushing instead of pulling it. In addition, the chuck 'T' was also developed by the appellant.

Conclusion:

Based onthe analysis performed the judge concluded

[123] Given that the respondent conceded that the research and development of the appellant as to the resin constitute SR & ED for tax years 2012 and 2013.

[124] Since I have concluded that the research and development of the appellant about the new chuck and chuck 'T', constitute SR & ED for tax years 2012 and 2103.

[125] Therefore, the call on the 2012 tax year is recognized in the amounts claimed for SR & ED of the resin and the mandrel.

Significant variables addressed: chuck design, composition of form, mandrel configurations & composition, push vs pull deployment

Documentation:

Uploaded to RDBASE.NET: 2017_CCI_42 Formadrain.pdf (278KB), Formadrain Technology - Formadrain _ Lateral & Spot Repair.pdf (236KB), Formadrain – improving process for repairing drains qualified as SR&ED.pdf (93.2KB)

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Sterol solubility (mg/oz)	10	40	Yes
Shelf life (months)	12	12	Yes
Suspension fall out (%)	60	2	Yes

The appellant had filed 12 years of successful SR&ED tax claims.

[2] In computing its income, the appellant claimed qualified SR&ED expenditures of $225,136 and investment tax credits (“ITCs”) of $78,798 for the taxation year ending June 30, 2010 and qualified SR&ED expenditures of $45,638 and ITCs of $15,973 for the taxation year ending October 31, 2010.

[3] The amounts initially claimed by the appellant were in respect of seven projects. Some of these projects continued over both of the taxation years in dispute. The projects were identified at the hearing by the project identification numbers given to them by the appellant. The projects originally at issue were projects 705, 801, 802, 803, 804, 805 and 806. However, since the appellant elected to proceed under the informal procedure, it decided to narrow the scopeof the appeal to two of the projects, 705 and 806. The appellant thus chose to waive any amount exceeding $25,000 for each taxation year at issue.

[4] The sole issue in this appeal is whether the appellant’s activities with respect to projects 705 and 806 constituted SR&ED within the meaning of the definition of SR&ED in subsection 248(1) of the Act.

II. FACTS
[5] The appellant was incorporated in 2000. Initially, its business consisted of selling flavours to the baking industry and salty snack seasonings to the snack food industry.3 Later, that portion of the corporation was sold to third parties, and the company entered the energy drink business.4 It was this later development that led to the appellant’s work on developing a beverage with plant sterols and other health-food ingredients.

[6] Gregory Schmalz is the appellant’s founder, president and sole shareholder. Mr. Schmalz holds a Bachelor of Science degree from the University of Waterloo. He has had a lengthy career in the flavour and fragrance industries. Mr. Schmalz testified that the work in question was performed by him and his assistant, Chris Melling.5 Mr. Schmalz was unable to confirm whether Mr. Melling had any educational background in science. However, he testified that he did not believe this to be the case.

[7] At the hearing, Mr. Schmalz was the only witness for the appellant. Ms. Azza Hassanein—a research and technology manager with the Canada Revenue Agency (the “CRA”) who evaluated the SR&ED claims made by the appellant—testified as the sole witness for the respondent. No experts were called by either party to testify at the hearing.

[8] Mr. Schmalz explained that the appellant’s purpose with respect to project 705 (the “Plant Sterols Beverage Project”) was to develop a beverage containing a mixture of 800 milligrams of plant sterols in a two-ounce format. Plant sterols are a natural cholesterol-reducing substance found in plant cell membranes. The U.S. Food and Drug Administration recognizes that a daily dose of 800 milligrams of sterols may reduce cholesterol and lessen the risk of heart disease, and it permits products to advertise their cholesterol-reducing properties if they contain the prescribed amounts of sterols. The appellant’s intention was that the two-ounce beverage be marketed for its cholesterol-reducing properties.

[9] With respect to project 806 (the “Partial Hot Fill System Project”), Mr. Schmalz explained that the appellant developed a pasteurization system that focused on pasteurizing only the active ingredients by pumping these ingredients in a side kettle and then pumping back the mixture into a larger tank. This method, according to Mr. Schmalz, was novel in that it was different from the hot fill method used by the industry. The two projects were interrelated in the sense that they were components of the same beverage production process and in the sense that the appellant hoped that the Partial Hot Fill System’s pasteurization process would aid in the dispersion of the desired amount of sterols in the two-ounce format, as required for the success of the Plant Sterols Beverage Project.

Field of Science/Technology:

Food and beverages (2.11.01)

Project Details:

Project Name:	Flavornet (LOSS)	**Start Date:**	2017-02-09
Project Number:	1706	**Completion Date:**	2017-10-31

Intended Results:	Develop new materials, devices, or products
Work locations:	Commercial Facility, Research Facility
Key Employees:	Gregory Schmaltz (Food Science - BSc. (1987) / President of Flavournet)
Evidence types:	Records of resources allocated to the project, time sheets; Design of experiments; Project records, laboratory notebooks

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[18] The issue, however, is that sterols are hydrophobic in nature, meaning that they do not dissolve well in water. The difficulty presented by the project was the development of a method of dispersing in two ounces of liquid an 800-milligram concentration of plant sterols. The appellant was aware that Cargill Corporation had a patent and had succeeded in dispersing plant sterols in orange juice, but Cargill was only able to disperse 400 milligrams in an eight-ounce serving.11 Therefore, the appellant was trying to develop a beverage in which the concentration of sterols was eight times higher than the concentration found in the orange juice product developed by Cargill.

III. APPELLANT'S POSITION
[24] The appellant's position is that the expenditures relating to the Plant Sterols Beverage Project and Partial Hot Fill System Project were made as part of "experimental development" within the meaning of the definition of SR&ED found in subsection 248(1) of the Act and thus the claimed SR&ED expenditures were qualified SR&ED expenditures and entitled the appellant to the related ITCs. The appellant argues that the Cargill patent represents the standard practice. In Mr. Schmalz's view, no one had been able to disperse such a large quantity of plant sterols in two ounces of liquid. Therefore, there was technological uncertainty as to whether 800 milligrams of plant sterols could be dispersed in such a small quantity of liquid.

The most significant underlying key variables are:

ingredients, temperatures, shearing methods, emulsifier integration

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	Various articles cited but not considered in court
Patent searches	1 patents	Cargil patent identified as benchmark

Activity #1-1: Research as described TCC judgment (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	122 alternatives
Trials:	8 runs / samples

[19] The appellant conducted various tests. For example, it used different heating temperatures, mixed the sterols with different ingredients to determine if the sterols would disperse better and completely, and tested different emulsifiers in conjunction with NutraFlora, which is a soluble fibre. As the project evolved, other health food ingredients ("nutraceuticals")—such as cocoa, green tea extract, and berries—were added to the mixture, both to enhance the health properties of the overall product and to aid in the dispersion of the sterols.

[20] Mr. Schmalz also explained that the appellant tested different mixing methods, for example, high-shear mixing, and mixing with a mechanical pump. Although, it is difficult to completely disperse 800 milligrams of sterols in two ounces of liquid, the appellant succeeded in dispersing 85% of the plant sterols; but there were still sediments that made the beverage unacceptable for market purposes.

B. Project 806-Partial Hot Fill System
[21] At the hearing, Mr. Schmalz explained that the objective of the Partial Hot Fill System Project was to develop a system that has the capability of pasteurizing two different liquid concentrates, subsequently diluting them and then filling them into a dual-chambered bottle at 25 degrees Celsius. According to Mr. Schmalz, the appellant's system differs from the industry-standard "hot fill" pasteurization system, which involves packaging the liquid when hot in special heat-resistant plastic or glass

bottles.

[22] Mr. Schmalz explained that the process in the Partial Hot Fill System begins with the addition of a small amount of sterilized water to the plant sterols and other nutraceutical ingredients—which produces what he described as a “slurry”. That mixture is then pasteurized by being pumped into the small side kettle, which is connected to the main tank, and heated to 50 degrees Celsius.13 The next step is to pump back the pasteurized mixture from the side kettle into the larger tank and to dilute it with sterile water, at which point the product is at room temperature and ready for bottling.

[23] According to Mr. Schmalz, he was seeking to develop an alternative to the traditional hot fill process in order to save energy and packaging costs, since plastic bottles are less expensive than glass bottles.14 In addition, it was also hoped that the heating process used in the Partial Hot Fill System would assist with the dispersion of the sterols and other nutraceuticals in the two ounces of water, thereby contributing to the realization of the Plant Sterols Beverage Project (i.e., the dispersal of the prescribed dosage of sterols in the two-ounce format).

Results:

- Sterol solubility: 22 mg/oz (40% of goal)
- Shelf life: 12 months (100% of goal)
- Suspension fall out: 38 % (37% of goal)

IV. RESPONDENT’S POSITION (CRA)

[27] The respondent argues that the activities undertaken by the appellant do not constitute eligible SR&ED within the meaning of the definition of SR&ED in subsection 248(1) of the Act.

[28] With respect to project 705, the Plant Sterols Beverage Project, the respondent argues that there were no technological uncertainties and no technological advancements since the appellant was using a methodology and techniques that were based on existing technology.

[29] In addition, the respondent argues that the evidence established that the appellant did not understand the concept of a hypothesis. Therefore, no clear hypothesis was formulated and the overall procedure followed by the appellant did not accord with the established principles of the scientific method.

[30] With respect to project 806, the Partial Hot Fill System Project, the respondent argues that the evidence did not establish that the project was developed during the years under appeal. In addition, she argues that the documents submitted by the appellant at trial generated even more confusion, relating to what project was under review for SR&ED purposes.

Conclusion:

[74] With respect to the formulation of a hypothesis, as with the Plant Sterols Beverage Project, the appellant did not formulate one, that is, it did not formulate an assumption to be tested in order to remove the technological uncertainty. In addition, there was no technological advancement since the appellant used means known to the industry to develop its system.

[75] The burden is on the appellant to establish that a project constitutes SR&ED within the meaning of subsection 248(1) of the Act. Project 806 was presented in a manner that was so confusing that it was impossible for me to determine if that project had to do with the dual-chambered bottle or the Partial Hot Fill System during the years under appeal. In any event, I am of the view that the Partial Hot Fill System did not meet the requirements for qualifying as SR&ED within the meaning of subsection 248(1) of the Act.

VI. CONCLUSION

[76] The respondent asked for costs under subsection 10(2) of the Tax Court of Canada Rules (Informal Procedure). I am of the view that the circumstances do not warrant costs.

[77] The appeal is dismissed with respect to project 705—the Plant Sterols Beverage Project—and Project 806 for the taxation years ending June 30, 2010 and October 31, 2010, since these projects undertaken by the appellant did not constitute SR&ED within the meaning of subsection 248(1) of the Act. There will be no award of costs.

Significant variables addressed: emulsifier integration, ingredients, shearing methods, temperatures

Documentation:

- Uploaded to RDBASE.NET: 2015-2330(IT)I Flavor Net Inc.pdf (314KB)

Activity #1-2: Questions on witness credibility (Fiscal Year 2017)

Methods of experimentation:

[10] Before starting my analysis of the appellant’s SR&ED projects, I would immediately emphasize that, as noted by the respondent, there is a discrepancy between the testimony of Mr. Schmalz with respect to the appellant’s SR&ED projects 705

and 806 and the description of these projects by the appellant in its T6616 form for both years under appeal. The T661 is a compulsory form that a taxpayer is required to file with its income tax return when claiming SR&ED expenditures and related ITCs. The T661 requires a taxpayer to describe the purpose of the SR&ED project, the activities undertaken, the technological risks, the uncertainties and advancements, and the approach followed. The CRA relies on the T661 to determine whether the activities of a taxpayer constitute SR&ED within the meaning of the definition of SR&DE in subsection 248(1) of the Act.

[11] With respect to project 705—the Plant Sterols Beverage Project—the respondent noted that the T661 of the appellant does not mention that the appellant was to develop a two-ounce shot in which the mixture would contain 800 milligrams of plant sterols. I agree with the respondent that the description in the T661 is vague. It is stated that the appellant's aim is to develop a health supplement in the form of a beverage using plant sterols. That said, since Ms. Hassanein, the technical reviewer at the CRA, stated in her testimony that she was aware at the time of her review that the purpose of project 705 was to[12] With respect to project 806, at the hearing, Mr. Schmalz testified that the appellant's purpose was to develop a Partial Hot Fill System. However, the description in the appellant's T661 with respect to project 806 for both years is focussed on the filling of a dual-chambered bottle. In the T661 for the year ending June 2010, project 806 is described as follows:

A dual chambered bottle with twin caps had never before been attempted to be filled by Flavour.Net Inc. Syncronization [sic] of the twin tank, pump, piping, filler reservoirs and filling heads was of the utmost importance. Through our trials it was shown that such a filling system can be designed that enables the benefits of the dual chambered bottle to be used in a variety of applications. By integrating a steam kettle as a mixing vessel for liquid concentrates success was achieved in duplicating hot fill results from the system. Significant effort was expended on the design of this unique filling system which is currently in use filling health supplement products. Further uses will be tested in the future.7

[13] In addition, in the appellant's submissions to the CRA, dated and signed by Mr. Schmalz, project 806 is described by the appellant as relating to the dual-chambered bottle:
Never before has Flavor.Net Inc. undertook [sic] to design a filling unit that can simultaneously fill two separate liquids into a dual chambered bottle and heat treat the liquid.8

[14] At the hearing, Ms. Hassanein testified with respect to project 806 that the appellant had described that project, as the filling of the dual-chambered bottle. Accordingly, it was the filling of the dual-chambered bottle that Ms. Hassanein reviewed for SR&ED purposes. Her written reports on project 806 confirm her testimony. In the report dated August 19, 20119 with respect to the taxation year ending June 30, 2010, Ms. Hassanein wrote as follows

regarding project 806:
This project was to design a filling unit that can simultaneously fill two separate liquids into a dual chambered bottle and heat-treat liquid. Natur can develop a unique filling system to fill a single bottle with two chambers and two caps creating a physical reminder to take a dose from each side. As well a capability for heat treating of the liquid to ensure microbial safety will need to be designed.
[15] The filling of the dual-chambered bottle and the Partial Hot Fill System are distinct projects; this was confirmed by Mr. Schmalz during the hearing.10

[16] Furthermore, the respondent submitted that I should not allow project 806 since it was far from clear from the documents filed in evidence at the hearing that the Partial Hot Fill System was developed by the appellant during the taxation years under appeal.al health supplements can require twice daily dosing.

Results:

[41] Furthermore, I am also not convinced by Mr. Schmalz's testimony regarding the state of knowledge regarding, and the technology available for, the dispersion of sterols at the time the project was undertaken. Mr. Schmalz referred throughout his testimony to a 2002 U.S. patent obtained by Cargill Inc. for a product in which 400 milligrams of sterols were mixed with orange juice in an eight-ounce format, which patent was entered into evidence as Exhibit A-4. According to Mr. Schmalz, this product reflected standard industry practice at that time.23 This patent was the sole evidence of any search conducted by the appellant, at the outset of the project, with regards to existing methods for dispersing plant sterols.

[42] In cross-examination, Mr. Schmalz was unable to recall the details of any searches undertaken. As I have said, the Cargill patent was the only specific evidence supplied by the appellant of any searches it undertook at the outset of the project. In cross-examination by counsel for the respondent, the following comments were made in reference to the Cargill patent:

Q. You call this a standard practice. Are there other patents that deal with plant sterols and the way to disperse them or dissolve them in water or liquid, or is that the only one?

A. I don’t know. Easy answer.

Q. Did you conduct a search to see if there were other patents dealing with

A. I am sure we did at the time and I couldn’t tell you the results of that because
I don’t remember.

Q. So what makes you think-- what makes you say that this is the standard
practice if you don’t know what the other ones

A. Because it led to commercialization in the marketplace of plant sterol infused orange juice
brands. It led to Cargill setting up, in their ingredient division,
sales of things like frozen blocks of pulp infused with plant sterols Q. Okay. So you may have conducted a search on other patents but today you’re not able to tell us
A. That’s right.
Q. whether there are other patents?
A. That is correct.

[43] In her testimony, Ms. Hassanein stated that, at the time of her review of the appellant’s project 705, there were multiple patents related to dispersing plant sterols in different products under different conditions.

[44] For these reasons, I conclude that the appellant has not succeeded in discharging its burden of establishing technological uncertainty since it was using methods and techniques that were available in the industry.

[45] While this finding alone is sufficient to dispose of the appeal with respect to the Plant Sterols Beverage Project,24 I will nevertheless proceed to apply as well the other criteria in Northwest Hydraulic Consultants Ltd. to the work undertaken by the appellant.

Conclusion:

Documentation:
Uploaded to RDBASE.NET: 705 project description.pdf (235KB)

Activity #1-3: 5 questions (Fiscal Year 2017)

Methods of experimentation:

See paragpraphs 35 to 62 of Tax Court Ruling

Compare to Appellant closing Arguments & evidence

Results:

Conclusion:

Documentation:
Uploaded to RDBASE.NET: Flavornet 5 questions in closing arguments.pdf (94.3KB), Flavornet Tax Court Position 5 Questions.pdf (188KB)

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Reliability (%)	65	99	Yes
Scalability (%)	100	8500	Yes
Availability (%)	96	99.9	Yes

Canada Revenue Agency (CRA) Eligibility of work in SR&ED projects containing software development - Transcript Mach 22, 2017

Slide 10:

As mentioned in an earlier slide, Experimental Development is undertaken for the purpose of achieving technological advancement.

So, what is technology?

Technology is not a physical entity.

Technology is the practical application of scientific knowledge and principles.

It is the knowledge of how scientifically determined facts and principles are embodied in the material, device, product, or process.

As technology evolves, the practical applications of scientific knowledge and principles as well as the technological knowledge associated with the products, processes, or devices become the scientifically determined facts and principles for further development.

Let's look at some examples to illustrate this.

Field of Science/Technology:

Software engineering and technology (2.02.09)

Project Details:

Intended Results:	Develop new processes, Improve existing processes
Work locations:	Lab
Key Employees:	
Evidence types:	Progress reports, minutes of project meetings; Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Design, system architecture and source code; Project records, laboratory notebooks; Project planning documents; Photographs and videos; Design of experiments; Records of trial runs; Contracts

Scientific or Technological Advancement:

Uncertainty #1: O/S design issues

Slide 11: Example 1:

A microcontroller or microprocessor can run machine code without an operating system and any user developed software can run directly on it.

In contrast, in an Operating System, user developed software runs within a managed environment.

The kernel has process management, memory management, and input/output (I/O) management to govern the environment.

Within process management, a scheduler manages tasks and processes using complex data structures working in conjunction with other embodiments. As we can see, within a modern Operating System, kernel and other embodiments not mentioned in the slide make up the scientifically determined facts and principles.

Similarly for the kernel, it is the process management, memory management, I/O management and others. As we go down further, the scheduler has Lists, Queues, etc.

The most significant underlying key variables are:

kernel - process, memory & I/O mgmt, process mgmt - scheduler lists & queues

Technology or Knowledge Base Level:

Activity #1-1: Big data examples (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	250 alternatives
Trials:	17 runs / samples

Slide 13:

We looked at the definition of technology through software examples.

New products/services are being built using or combining various technologies for creating complex applications. This is driving relentless progress.

The trend in software development has shifted in the direction of shared services such as Software as a Service, Platform as a Service and Infrastructure as a Service.

We see this manifest as Cloud computing which is made possible by tremendous advancements in hardware and software technologies.

From software perspective, Cloud services became possible through advancement in networking and distributed infrastructure and computing.

All these developments make use of various advancements in software technology stack.

This is an illustration of how various advancements provide a platform for modern big data applications.

Results:

- Reliability: 88 % (67% of goal)
- Scalability: 4400 % (51% of goal)
- Availability: 99.3 % (84% of goal)

Conclusion:

As you all know, different companies compete in different areas of technology. For example, a company working on scalable distributed computing and processing deals with different technologies than a company working on databases or content delivery network. These companies have the potential of advancing technology in their respective areas.

Significant variables addressed: kernel - process, memory & I/O mgmt, process mgmt - scheduler lists & queues

Uncertainty #2: Micro processors

Slide 12:

Even when we use a microcontroller without an Operating System, the tools used to generate the machine code can come from a tool-set.

For example, a well known open source electronic platform provides a tool which uses the principles of programming language to enable writing in a higher level language, uses the principles of compiler that turns the code into object files (machine readable instructions), and a linker to combine the object files with libraries.

Principles of programming languages, compiler, linker, and Graphical User Interface are some of the scientifically determined facts and principles within the tool-set.

Similar evolution can be seen in technologies associated with Web systems, Information systems, micro-controller based systems, relational databases, No-Structured Query Language (SQL) databases, distributed storage and retrieval etc.

The most significant underlying key variables are:

programming languages, compilers, linkers, Interface

Technology or Knowledge Base Level:

Activity #2-1: Technology vs. features (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	147 alternatives
Trials:	13 runs / samples
Physical prototypes:	7 samples
Lines of code:	14800 Lines of prototype code

Slide 14:

Companies produce various products and services using technology. SR&ED looks at the advancement in technology necessary to deliver the new or improved products and services. Therefore it is important to distinguish between technology and product.

Often the name of the product, process, or device is also used to identify the technology.

The distinction is:

Product, process, or device conveys feature, functionality, capability, etc.

Technology is about the knowledge of how the constituents embodied within the product, process or device, function to deliver the feature, functionality, capability, etc.

For example: Web information system publishing tools that also serve as document management and storage systems come with features, interfaces, application program interfaces (APIs) and tool-sets to build information systems.

Results:

Conclusion:

Slide 15:

Understanding the capabilities and limitations of such systems for building an information system, use of their API/interfaces to develop an information system, or information about their features and functionality are about a product.

On the other hand, knowledge of the internal workings of such systems and how inter-relationships produce, influence, and impact the features, interfaces, APIs, tool-sets etc., are related to the technology.

Significant variables addressed: compilers, Interface, linkers, programming languages

Documentation:

- Offline Documents: Supporting documentation

Uncertainty #3: Other areas

Slide 48:

Technological advancements in software development projects can involve:

New or improved techniques and methods in computing to store, search, process, and manage vast collection of data (big data). Typically undertaken in Universities and large research labs.

Advancements necessary in support of software technology stack or tools.

Advancements necessary for new or improved infrastructures like internet driven Cloud and distributed computing.

Advancements necessary to support scaling, reliability and availability of software based systems.

Advancements in other technology areas like vision and medical imaging, video transmission, telecommunication (voice), automation, controls, etc.

The most significant underlying key variables are:

improved infrastructure options (unresolved), scaling, reliability & availability options (unresolved), vision design options (unresolved), technology stack or tool designs (unresolved), big data methods (store, process, manage) (unresolved)

Technology or Knowledge Base Level:

Activity #3-1: Ineligible activities (Fiscal Year 2017)

Methods of experimentation:

Slide 27:

We will now look at a few examples to illustrate common misconceptions about technological uncertainty. The first example is to emphasize that absence of a capability does not equate to a technological uncertainty.

A company wants to build a new version of their client server mobile application. The older version of the application worked in conjunction with a well known Enterprise Server that offered server side Push. The new version of the application was required to work in setups where the Enterprise server could not be used.

In client server applications, the server responds to client requests. With a server side Push service, client applications can receive information from their servers even if they did not initiate a request.

Results:

Conclusion:

The company cannot claim the lack of availability of the Push capability from the Enterprise server as a technological uncertainty for its work to build some form of a Push service.

The company has to identify a limitation of technology that is preventing the development of its own Push service.

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Learn new methods (?)	(not set)	(not set)	No
Achieve results (?)	(not set)	(not set)	No
Optimality (%)	(not set)	(not set)	No
Completeness (%)	(not set)	(not set)	No
Accuracy and precision (%)	(not set)	(not set)	No
Execution time (seconds)	3.2	2.2	No
Virus scanning (%)	97	99.8	No

The following information is based on the article " The challenges of patenting artificial intelligence, November 27, 2017" by Stacy Rush of Ridout Maybee, LLP as published in Canadian Lawyer. Many of the issues related to patents apply to R&D Grant & SR&ED tax credit eligibility.

Artificial intelligence's "black box" decision-making presents challenges for AI and machine learning innovators who want to file for patents. Practitioners need to consider the unique properties of AI technology to secure meaningful and enforceable patent protection for these inventions.

The problem: "Black box" AI algorithms

Machine learning relies on training a piece of software to make decisions by providing feedback on the output it produces while processing a set of training data.

The programmers create the initial structure of the software and define the feedback heuristics used to train it, but the software produced by the training process is often a jumble of weights and interconnections between nodes in a neural network or some similarly human-illegible chunk of math.

Thus, while AI systems created via ML often exhibit highly effective decision-making, they do so without providing their creators (or anyone else) any meaningful insight as to the underlying logic of the system.

Field of Science/Technology:

Software engineering and technology (2.02.09)

Project Details:

Intended Results:	Develop new processes, Develop new materials, devices, or products, Improve existing processes, Improve existing materials, devices, or products
Work locations:	Commercial Facility, Lab
Key Employees:	
Evidence types:	Records of resources allocated to the project, time sheets; Progress reports, minutes of project meetings; Test protocols, test data, analysis of test results, conclusions; Design, system architecture and source code; Project planning documents; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Patents and artificial intelligence

A patent is a bargain with the public. An inventor applying for a patent is required to disclose the nature of the invention, including instructions for building it, to the public — in exchange, he or she is granted a limited monopoly, usually for a period of 20 years. The public is granted access to the workings of the invention in perpetuity thereafter.

In the context of AI and ML, inventors are faced with hard decisions about how to satisfy this disclosure requirement. What constitutes proper disclosure about the workings of a “black box” AI invention when the inventor herself does not always understand how it works?

Further, how much detail is needed to describe the intricate (and commercially sensitive) training protocols by which a mature ML system is created?

A national patent office will examine the invention through the lens of public policy, including policies against the monopolization of abstract ideas: How can the inventor overcome the issues outlined above and describe the workings of the algorithm so as to satisfy the patent examiners — and the courts — that inventors are entitled to a patent for their inventions?

Considerations for patenting an ML system

One fundamental question that requires consideration is what parts of the technology are being claimed as the invention? An inventor will need to make choices about how much they want a patent to focus on protecting the processes by which the system is created, trained and validated, as opposed to focusing on the final product deployed after these processes have run their course.

Another issue that requires consideration is the question of subject matter eligibility. To qualify as proper subject matter for a patent in these jurisdictions, an AI-based technology generally needs to be something more than an “abstract idea.” The patent office needs to be convinced that a specific “technical problem” is being overcome by the invention in order to have the patent issued. (See Alice Corp. v. CLS Bank International). This hurdle is easier to overcome if the application includes claims directed to specific implementations of the technology, such as:

Specific hardware (e.g. sensors, remote devices, autonomous vehicle controls, processor architectures);
Specific details about the training data or how that data is processed by the system;
Specific data structures implementing an AI or ML system (e.g. a neural network);
Specific heuristics being used for decision-making and/or training feedback; and
Technical improvements to the functioning of a computer.

The most significant underlying key variables are:

SPECIFIC DETAILS ON (unresolved), Hardware (architectures, devices...), Data sets & structures, Heuristics for decision making (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Specific vs General Objectives (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	60000000 alternatives
Trials:	1 runs / samples

With regard to AI and ML inventions, the United States Patent and Trademark Office and U.S. courts have provided some guidance to patent eligibility:

- as one example, a patent application for an ML system that simply describes possible specific data structure implementations (e.g. neural networks) may be rejected by the USPTO (See Ex Parte Kirshenbaum, Board of Patent Appeals and Interferences, Appeal 2007-3223),

- whereas an application that restricts the claimed monopoly to such a specific implementation may be allowed (See Ex parte Bramlett, Patent Trial and Appeal Board, Appeal 2015-002707).

By including technical implementation details of the AI or ML system in the patent claims and specification, the inventor should be able to overcome common pitfalls. However, there are trade-offs involved in this choice.

Specifically, if patent claims limit an invention to a specific implementation, the patent may be difficult to enforce:

first, because a patent owner may not be able to detect when a competitor is using an invention as part of their product or service and,

second, because it may be easy for a competitor to design around the specific implementation claimed in the patent by employing an alternative implementation.

Results:

These considerations of enforceability take practitioners outside of the purely technical realm and require practitioners to consider the details of the market in which the business operates. Before drafting the claims, a patent agent should be fully briefed on these market factors, including:

- Who the competitors are;
- Which features of the new technology competitors are most likely to infringe;
- How such infringement could be detected; and
- Which other market actors a company would (or could) sue in the event of infringement.

Conclusion:

An effective patent strategy to protect AI-related inventions should take into account all of the issues of patentability and enforceability set out above, tailored to the realities and needs of the business.

Practitioners need to consider the unique properties of AI technology to secure meaningful and enforceable patent protection for these inventions.

Stacy Rush is an associate in the Toronto office of Ridout & Maybee LLP – a boutique intellectual property firm. Stacy's practice focuses on assisting with the preparation and prosecution of patent applications in the areas of software and computer-related devices, gaming, and medical device technologies.

Matt Norwood is an associate in the Toronto office of Ridout & Maybee and assisted in the writing of this column. Matt's focus is directed towards litigation of intellectual property disputes and advising clients on IP licensing matters. Matt also assists with the drafting and prosecution of patent applications with an emphasis on electrical and computer related technology.

Significant variables addressed: Data sets & structures, Hardware (architectures, devices...)

Documentation:

- Uploaded to RDBASE.NET: The challenges of patenting artificial intelligence _ Canadian Lawyer Mag.pdf (475KB)
- Offline Documents: Typical documentation

Uncertainty #2: Heuristics (computer science)

HEURISTIC (COMPUTER SCIENCE) - FROM WIKIPEDIA

In computer science, artificial intelligence, and mathematical optimization, a heuristic (from Greek "I find, discover") is a technique designed for solving a problem more quickly when classic methods are too slow, or for finding an approximate solution when classic methods fail to find any exact solution.

This is achieved by trading optimality, completeness, accuracy, or precision for speed. In a way, it can be considered a shortcut.

A heuristic function, also called simply a heuristic, is a function that ranks alternatives in search algorithms at each branching step based on available information to decide which branch to follow. For example, it may approximate the exact solution.

TRADE OFF CRITERIA:

The trade-off criteria for deciding whether to use a heuristic for solving a given problem include the following:

Optimality: When several solutions exist for a given problem, does the heuristic guarantee that the best solution will be found? Is it actually necessary to find the best solution?

Completeness: When several solutions exist for a given problem, can the heuristic find them all? Do we actually need all solutions? Many heuristics are only meant to find one solution.

Accuracy and precision: Can the heuristic provide a confidence interval for the purported solution? Is the error bar on the solution unreasonably large?

Execution time: Is this the best known heuristic for solving this type of problem? Some heuristics converge faster than others. Some heuristics are only marginally quicker than classic methods.

In some cases, it may be difficult to decide whether the solution found by the heuristic is good enough, because the theory underlying that heuristic is not very elaborate.

PITFALLS:

Some heuristics have a strong underlying theory; they are either derived in a top-down manner from the theory or inferred from experimental data. Others are just rules of thumb learned empirically without even a glimpse of theory. The latter are exposed to a number of pitfalls.

When a heuristic is reused in various contexts because it has been seen to "work" in one context, without having been mathematically proven to meet a given set of requirements, it is possible that the current data set does not necessarily represent future data sets (see: overfitting) and that purported "solutions" turn out to be akin to noise.

Statistical analysis can be conducted when employing heuristics to estimate the probability of incorrect outcomes. To use a heuristic for solving a search or a knapsack problem, it is necessary to check that the heuristic is admissible.

If a heuristic is not admissible, it may never find the goal, either by ending up in a dead end of graph.

The most significant underlying key variables are:

combinations, types - top down, inferred, rule of thumb (unresolved), admissibilities (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	Wikipedia illustrations of computer science heuristics

Activity #2-1: Heuristic design (Fiscal Year 2017)

Methods of experimentation:

Examples

Simpler problem
One way of achieving the computational performance gain expected of a heuristic consists of solving a simpler problem whose solution is also a solution to the initial problem. Such a heuristic is unable to find all the solutions to the initial problem, but it may find one much faster because the simple problem is easy to solve.

Traveling salesman problem
An example of approximation is described by Jon Bentley for solving the traveling salesman problem (TSP) so as to select the order to draw using a pen plotter. TSP is known to be NP-Complete so an optimal solution for even a moderate size problem is intractable.

Instead, the greedy algorithm can be used to give a good but not optimal solution (it is an approximation to the optimal answer) in a reasonably short amount of time. The greedy algorithm heuristic says to pick whatever is currently the best next step regardless of whether that precludes good steps later. It is a heuristic in that practice says it is a good enough solution, theory says there are better solutions (and even can tell how much better in some cases).

Search
Another example of heuristic making an algorithm faster occurs in certain search problems. Initially, the heuristic tries every possibility at each step, like the full-space search algorithm. But it can stop the search at any time if the current possibility is already worse than the best solution already found. In such search problems, a heuristic can be used to try good choices first so that bad paths can be eliminated early (see alpha-beta pruning).

Newell and Simon: heuristic search hypothesis
In their Turing Award acceptance speech, Allen Newell and Herbert A. Simon discuss the heuristic search hypothesis: a physical symbol system will repeatedly generate and modify known symbol structures until the created structure matches the solution structure.

Each successive iteration depends upon the step before it, thus the heuristic search learns what avenues to pursue and which ones to disregard by measuring how close the current iteration is to the solution. Therefore, some possibilities will never be generated as they are measured to be less likely to complete the solution.

A heuristic method can accomplish its task by using search trees. However, instead of generating all possible solution branches, a heuristic selects branches more likely to produce outcomes than other branches. It is selective at each decision point, picking branches that are more likely to produce solutions.

Virus scanning
Many virus scanners use heuristic rules for detecting viruses and other forms of malware. Heuristic scanning looks for code and/or behavioral patterns indicative of a class or family of viruses, with different sets of rules for different viruses.

If a file or executing process is observed to contain matching code patterns and/or to be performing that set of activities, then the scanner infers that the file is infected.

The most advanced part of behavior-based heuristic scanning is that it can work against highly randomized polymorphic viruses, which simpler string scanning-only approaches cannot reliably detect.

Heuristic scanning has the potential to detect many future viruses without requiring the virus to be detected somewhere, submitted to the virus scanner developer, analyzed, and a detection update for the scanner provided to the scanner's users.

Results:

ADVANCEMENT FROM MACHINE LEARNING & AI COULD BE IN THE FORM OF:

1) SOFTWARE & HEURISTIC TECHNOLOGY

2) IMPROVED MATERIALS & DEVICES (NON-SOFTWARE)

Conclusion:

TECHNOLOGICAL ADVANCEMENTS WILL LIKELY BE IDENTIFIABLE IN PROJECTS THAT PROVIDE "SPECIFIC" OBJECTIVES & SCOPE.

Significant variables addressed: combinations

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Remove 2 layers of liner (1=Yes / 0 =No)	0	1	Yes
Remove only inner liner (1=Yes / 0=No)	0	1	Yes
Avoid pipe damage (mm)	5	2	Yes

This project example is based on the tax court case of MAC & MAC HYDRODEMOLITION SERVICES INC. vs. THE QUEEN Docket: 2017-1942(IT)I (Oct 27, 2017)

Mac & Mac Hydrodemolition Services Inc. tax credits for two different projects. Both projects involved large metal pipes used to transport bitumen. The inside of the pipes was lined with a quarter inch of rubber and that rubber, in turn, was coated by a one-inch polyurethane coating. Over time, the bitumen travelling through the pipes caused wear to the lining, which meant that eventually the pipe had to be replaced.

For the purpsoes of this example we will consider these 2 projects as separate activites in the same project.

Mac & Mac was approached by a potential client to see if Mac & Mac could develop a method of removing the entire lining without damaging the pipe. The first activity was to develop a method of removing the entire lining.

After Mac & Mac succeeded in this goal, the second activity was to develop a method of removing only the polyurethane lining while leaving the rubber lining intact.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Lab
Key Employees:	
Evidence types:	Samples, prototypes, scrap or other artefacts; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Removing entire lining

Mac & Mac tried many different techniques to remove the linings. As Mac & Mac's company name indicates, its speciality is hydrodemolition. Thus, all of the techniques that Mac & Mac employed involved the application of high-pressure water.

It tried hydraulicing, cutting and milling. Hydraulicing involves using a water jet to pierce through the material that you are trying to remove in such a way that large pieces of the material are removed when the water rebounds from the hard surface behind the material.

The most significant underlying key variables are:

nozzle size & distance (unresolved), nozzle speed, spin, rotation (unresolved), water pressures & spray angles (unresolved), length of nozzle arms (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes

Internet searches	3 Articles	IDEALLY THE CLAIMANT WOULD ILLUSTRATE THE SOURCES USED TO BENCHMARK EXISTING METHODS.
Patent searches	8 patents	PRIOR ART SEARCH EXAMPLE - HOW TO SKIM PATENTS

Activity #1-1: Hydraulicing to remove entire lining (Fiscal Year 2017)

Methods of experimentation:

Mac & Mac began the first project by trying hydraulicing. The initial approach was to use two nozzles attached to a device that they would drag through the pipe.

Changes that Mac & Mac tried included using different angles of spray, using different water pressures, increasing the number of nozzles, altering the size of the nozzles, adjusting the distance between the nozzles and the linings, making the arms on which the nozzles were mounted rotate, changing the length of the arms, making the nozzle heads themselves spin, altering the speed of the arm rotation, altering the speed of the nozzle spin, adjusting the speed with which the nozzles were moving through the pipe, and adjusting the means by which the apparatus was moved through the pipe. Mac & Mac changed only one of these variables at a time.

Results:

- Remove 2 layers of liner: 1 1=Yes / 0 =No (100% of goal) -- SUCCEEDED IN REMOVING 2 LAYERS
- Avoid pipe damage: 3 mm (66% of goal)

Conclusion:

Uncertainty #2: Removing plastic liner

Cutting involves using a focused water jet to removing very small slices of material one at a time. Milling involves removing one layer of material at a time until, after multiple passes over the material, it is all gone.

The most significant underlying key variables are:

differing simultaneous water pressures (unresolved), pipe rotation speeds & directions (unresolved), number of passes (unresolved)

Technology or Knowledge Base Level:

Activity #2-1: Milling method to remove only plastic lining (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives
Trials:	50 runs / samples
Physical prototypes:	8 samples

Hydraulicing and cutting would not work for the second project so Mac & Mac had to develop a method of milling. This required a different process than that used in the first project.

Changes that Mac & Mac tried included using two different pressures of water at the same time, rotating the pipe itself (both in the same direction as the arms and in the opposite direction), altering the speed of the rotation of the pipe, altering the number of passes that the apparatus made through the pipe, altering the speed of those passes, mounting the apparatus on a long beam instead of wheels, changing nozzle heads between passes, and changing the water pressure between passes. Mac & Mac had to to find a beam construction that was strong enough to withstand the kickback from the water yet light enough to avoid sagging. Again, Mac & Mac changed only one of these variables at a time.

Results:

- Remove only inner liner: 1 1=Yes / 0=No (100% of goal) -- SUCCEEDED IN REMOVING SINGLE LINER.
- Avoid pipe damage: 2 mm (100% of goal) -- ABLE TO ACHIEVE MINIMAL DAMAGE TO PIPE INTERIOR.

THE JUDGE COMMENTED:

[8] Mac & Mac kept a set of handwritten notes. The notes were compiled weekly. The notes describe the various parameters that were being tested in only vague terms. The notes do not contain any hypotheses. There is no way of telling what Mac & Mac hoped to achieve from the changes. The notes also contain scant details about the changes being made. For example, the notes indicate that Mac & Mac tried different nozzle sizes and angles but they do not specify what those sizes or angles were. Finally, the notes contain very little information about the results of the tests. Given the large number of parameters described above, I would have expected the notes to have been much more detailed. There is simply no way that someone, even someone very experienced in the industry, could hope to replicate or confirm Mac & Mac's results from these notes.

[9] A spreadsheet was also entered into evidence. It provided more detail than the notes. However, it was prepared after the fact for the purpose of supporting the SR&ED claim and still did not contain the level of detail I would have expected. I have not given the spreadsheet any weight.

Conclusion:

BASED ON THE EVIDENCE PROVIDED THE JUDGE RULED:

[10] As noted by Justice Bocock in Highweb & Page Group Inc. v. The Queen:

. . .While evidence of the outcome is important, it is critical to technological advancement that the rigours of adherence to the scientific and experimental method be kept on a detailed and concurrent basis with the conduct of the experiments. Since a negative answer to the hypothesis is a more frequent outcome and frequently as helpful in advancing technological knowledge, detailed step-by-step logging, analysis, and measurement is a mandatory requirement, not an optional addendum. It is the roadmap. If one loses the way and failure results, retracing through these accurate records provides one with the deductive process for developing a different direction, speed or mode to create, locate, size, and arrange the "missing piece in the puzzle". . . .

AUTHOR'S NOTE:

UNLIKE OTHER SR&ED CASES THIS CASE DID NOT PROVIDE DETAILS ON THE TECHNICAL BACKGROUNDS OF THE INVESTIGATORS.

WITH MORE DETAILED RECORDS OF THE EXPERIMENTATION THE CASE WOULD LIKELY HAVE SUCCEEDED. FOCUS WILL BE GIVEN TO CONCURRENT VS. AFTER THE FACT EVIDENCE.

Documentation:

Offline Documents: JUDGE CONCLUDED INADEQUATE DOCUMENTATION

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Energy efficiency (kw/h)	50	15	Yes
Scalabilty (# total nodes)	1000000	100000000	Yes
Reduce redundant operations (%)	50	5	Yes
Achieve FAIR distribution among nodes (% accuracy)	80	95	Yes
Reduce message overhead (%)	100	40	Yes

NOTE: THIS PROJECT DESCRIPTION IS BASED ON THE CANADA REVENUE AGENCY EXAMPLE RELEASED OCTOBER 2018.

We are specialized in social media field. Our existing Social Media Platform was developed to allow users to gain cash rewards based on their contributions. We seek to reward them using cryptocurrency. For better market share, our objective was to develop a new cryptocurrency which will be more energy efficient than the existing cryptocurrencies.

Cryptocurrencies rely on Blockchain networks and use consensus mechanisms to validate financial transactions. Existing Proof of Work (PoW) consensus mechanism guarantees a fair distribution of mining chances but it suffers from an overall energy consumption issue since the validation operations are duplicated.
Enhancements to this consensus mechanism (e.g. using mining pools) or alternative mechanisms, such as Proof of Stake (PoS), can reduce the number of redundant operations, but result in a monopoly in terms of validation chances among miners.

We seek to achieve at least 30% reduction in the overall energy consumption without degrading fairness among miners. To do so, we thought about augmenting PoW by adding probabilistic behaviour to limit the access to transactions validation.

Field of Science/Technology:

Software engineering and technology (2.02.09)

Project Details:

Intended Results:	Develop new processes
Work locations:	Lab
Key Employees:	Software Developer (Unknown / Unknown)
Evidence types:	Progress reports, minutes of project meetings; Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Adapt backoff mechanism

We found that the backoff mechanism, used in wireless networks (WLANs) for medium access control, may be a candidate for such objective. This mechanism uses random timers to grant access to the channel in a distributed fashion while reducing the collision rate. Overall, all the nodes have equal chance to access the channel. Also, this mechanism adapts very well to network congestion.

Our idea was to transpose such behavior into Blockchain. Collisions (concurrent transmissions) in WLANs will mean duplicate validations in Blockchain. But, the backoff mechanism cannot be directly applied to Blockchain because, in WLANs, this mechanism is designed to share access to one channel, whereas in Blockchain we can have multiple transaction validations occurring simultaneously. Also, once a transaction is validated, there is no need for the backoff mechanism to be associated to this specific transaction.

Therefore, there is uncertainty in whether the backoff mechanism principles can be adapted to the specific nature of Blockchain networks and achieve the objective of processing transactions with minimal duplicates while keeping fairness among the nodes.

The most significant underlying key variables are:

number of nodes, dynamicity (# of joins & leaves), neighbourhood size & definition, single POW vs multiple blockchain channels, propogation radius

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	17 Articles	examined differing uses and methods to deploy backoff mechanism
Competitive products or processes	6 products	examined collision mechanisms of 6 existing blockchain products

Activity #1-1: Activity 1 (Fiscal Year 2018)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	17 alternatives
Trials:	438 runs / samples
Physical prototypes:	3 samples
Lines of code:	7300 Lines of prototype code

From September to January, we thought about ways to apply the backoff mechanism principles to the overall Blockchain network.
One candidate solution was to create a variant of the backoff mechanism in which, when a new transaction is ready for validation, each set of nodes willing to validate that specific transaction will be considered as a separate channel and have a specific backoff mechanism attached to them. Thus, at a given point in time, multiple dynamic instances of the backoff mechanism will be running in parallel.

Moreover, in WLANs, the backoff mechanism relies on the capability of carrier sensing (CS) to perform its elementary timer operations (start, pause, resume, cancel), meaning that wireless nodes are able to sense if there is nearby activity.
In Blockchain, which relies on P2P topology, there is no way for a node to get a sense about the activity of the other nodes.
We thought about how we can emulate the lacking CS capability in P2P to allow miners to be informed about other mining activities. This is key to applying the principles of backoff mechanism to achieve our objectives.
Our idea was to create “regions” of miners allowing them to detect the level of localized mining activities within their neighborhood (a specific number of hops) and correctly apply the backoff timers operations only if the activity is related to the same transaction they want to validate.
The optimal neighborhood size has to be determined since the propagation of such information within a small (resp. large) neighborhood will result in less accurate emulation of CS, thus more collisions (resp. larger network messages overhead and bigger delays due to routing).

We wanted to validate through simulation the effectiveness of the use of the backoff mechanism as an enhancement to PoW. We called our new consensus mechanism Fairness of Work (FoW). We designed minimalistic models of PoW and FoW and implemented them in an open-source discrete-event simulator.
We defined parameters that will be used for input such as the number of nodes, the degree of dynamicity (joins/leaves) of the P2P network, the number of operations to validate, the neighborhood size, etc.
We also defined the performance metrics for evaluation of FoW against PoW, such as the number of redundant mining operations, the distribution of mining among the nodes and message overhead.
We then conducted many simulations, each with the same set of random conditions for both PoW and FoW.

Simulation results showed that the overall number of redundant mining operations was reduced by 40% while keeping a fair distribution of mining chance between miners. The performance of FoW starts to degrade when the size of the Blockchain network exceeds 200K nodes.

From February to June, we modified an open source Blockchain software client to include our new FoW mechanism. Then, we tested this mechanism using a small network in a real-world setting. Results were similar to simulation results, which validated the models used in the simulation and allowed us to create a model for PoS and run simulations to compare FoW against PoS without real-world settings.

Earlier work related to the integration of SMP with ccCoin and benchmarking of hardware mining devices to select the best candidate in terms of energy consumption was not claimed.

Results:

- Energy efficiency: 25 kw/h (71% of goal)
- Scalabilty: 110000000 # total nodes (110% of goal)
- Reduce redundant operations: 11 % (86% of goal)
- Achieve FAIR distribution among nodes: 97 % accuracy (113% of goal)
- Reduce message overhead: 23 % (128% of goal)

NOTE: THE IDEAL DESCRIPTION WOULD COMPARE RESULTS TO INITIAL GOALS & EXPECTATIONS THEN TRY TO EXPLAIN ANY VARIANCES.

Conclusion:

We have shown that the principles of the backoff mechanism, used for medium access control in WLANs to reduce frame collisions, can be applied to reduce energy consumption in Blockchain without creating mining monopoly.

We have found that dynamic instances of this mechanism can run in parallel and achieve the desired results. Also, it is possible to rely on partial information about transaction validation within regions of miners to emulate the carrier sensing capability. By combining both ideas, it is possible to reduce the number of mining operations within the overall Blockchain network.

Analysis of our experimental results shows that we can successfully reduce the amount of redundant mining operations by 40% while having a fair distribution of mining chance among miners. Our new mechanism, FoW, outperforms both the legacy PoW and PoS.

However, the results show that our FoW mechanism does not scale well for large Blockchain networks (beyond 200K active miners) due to the non-convergence of the propagation mechanism introduced to emulate the lack of carrier sensing capability. Increasing the propagation radius can possibly solve this problem for networks with low degree of dynamicity (join/leave).

Significant variables addressed: dynamicity (# of joins & leaves), neighbourhood size & definition, number of nodes, propogation radius, single POW vs multiple blockchain channels

Documentation:

- Offline Documents: Docs

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
supported workpiece max. (tons)	50	100	No
unsupported workpiece max. (tons)	40	80	No
length of workpiece (m)	10	13	No
precison of finish (thou./in)	4	2	No

This project example is based on the Tax Court of Canada case of A & D PRECISION LIMITED vs. THE QUEEN Citation: 2019TCC48

The claimed SR&ED current expenditures are for the 2006, 2007 and 2008 fiscal periods with total federal ITCs of $1,212,213 across 2 projects.

Background of key investigators

Antranik Derbedrosian testified as one of A&D’s two main fact witnesses. He is the founding owner, president, sole shareholder and director of A&D. Mr. Derbedrosian has little formal education, but considerable experience since childhood in machine shops and at 13 started a five year machinist apprenticeship. He came to Canada in 1969 at age 22 and started A&D in 1974 as a one-man shop. At the time of the hearing of this appeal, A&D employed over 30 persons. Mr. Derbedrosian does not hold any engineering designation.

George Predoiu testified also, as A&D’s other main fact witness. Sadly, Mr. Predoiu has since passed away. During much of the subject time period he was, through a personal corporation, a subcontractor of A&D. Mr. Predoiu was an Ontario registered professional engineer. He had formal training at the University of Bucharest in Romania as a mechanical engineer before coming to North America. He had a distinguished 47 year career in the design and assembly of machine tools, including work with Northstar Aerospace in Milton, Ontario, General Dynamics in Marion, Virginia and the U.S. Air Force.

Objectives & background:
Prior to 2000, A&D had used horizontal lathes purchased from an Italian manufacturer - Safop. Upon GE becoming more demanding in its specifications for turbine components that A&D sought to manufacture, these lathes no longer were sufficiently precise for GE work. After engaging in some due diligence enquiries, A&D decided to purchase three new large horizontal lathes from another Italian company, Tacch which was considered an international leader in the building of CNC (computer numerical control) heavy duty lathes.

However, performance issues soon developed, including headstock vibration, imprecise z-axis carriage movement and overnight sliding of the tailstock. The one year warranty period for the Tacchis passed, allowing A&D itself, not solely Tacchi, to try to fix or improve these lathes, but without success.

Consequently A&D per Mr. Derbedrosian concluded that the Tacchi lathes should be sold, and that A&D should build its own lathes to be able to continue manufacturing large turbine components for GE with heightened tolerance requirements.

Mr. Derbedrosian came up with the original concept for the 80 ton horizontal lathe. That concept was that that lathe, known as the 80 ton Matteo, would be capable of turning an unsupported workpiece of 80 tons weight (or 100 tons with use of a steady rest to support the workpiece) and 13 metres in length, while meeting rigorous tolerance specifications in machining the workpiece.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results: Improve existing processes

Project Name:	A&D Precision “Full spectrum versatile horizontal lathes” (WIN)	**Start Date:**	2006-01-15
Project Number:	1901	**Completion Date:**	2009-01-07

Work locations: Commercial Facility

Key Employees: George Predoiu (mechanical - BASc. (1970) / PEng.), Tony Derbedrosian (Metal forming - Machinist (1974) / President)

Evidence types: Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Design, system architecture and source code; Photographs and videos; Records of trial runs; Contracts

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[61] The CRA’s submission was that if the welded (rather than cast iron) structure of the 80 ton Matteo, and inertia and deflection due to the unprecedented weight and length of an 80 ton and 13 metre workpiece gave rise to technological uncertainties, the uncertainty was overcome by A&D using known solutions.

Steps to define prior art:

Use of expert witnesess:

As well, two experts were called A&D – Drs. Stephen Veldhuis and Eu-Gene Ng. The CRA in turn called Dr. Yusuf Altintas as its expert. All are university affiliated and have advanced expertise in machine tool design and testing. The judges stated, "Their evidence was of general assistance to me in my reaching the conclusions noted herein."

[59] The Respondent’s expert, Dr. Altintas, acknowledged in testimony that system uncertainty could constitute a technological uncertainty:
When you put the machine - all the parts together, all this uncertainty is now merged, accumulated. Now, the system has uncertainty. I call that - this is my definition - people may say - I call this technological uncertainty, now, because you have a technology, now. The whole machine together. (transcript, p. 2349)

The most significant underlying key variables are:

methods to control inertia & deflection, welded vs cast iron structure

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	IDEALLY THE CLAIMANT WOULD HAVE CITED THE MAJOR DOCUMENTS USED TO BENCHMARK THE METHODS & PERFORMANCE OF EXISTING TECHNOLOGY.
Patent searches	5 patents	EXAMPLE OF PRIOR ART SEARCH USING GOOGLE PATENTS

Activity #1-1: Adapt Tachi lathes (Fiscal Year 2006)

Methods of experimentation:

[13] Prior to 2000, A&D had used horizontal lathes purchased from an Italian manufacturer - Safop. Upon GE becoming more demanding in its specifications for turbine components that A&D sought to manufacture, these lathes no longer were sufficiently precise for GE work. After engaging in some due diligence enquiries, A&D decided to purchase three new large horizontal lathes from another Italian company, Tacchi Giacomo e Figli SpA (Tacchi). A&D anticipated that these three Tacchi lathes would enable it to achieve GE’s more demanding specifications. Tacchi was considered an international leader in the building of CNC (computer numerical control) heavy duty lathes.

[15] However, performance issues soon developed, including headstock vibration, imprecise z-axis carriage movement and overnight sliding of the tailstock. The one year warranty period for the Tacchis passed, allowing A&D itself, not solely Tacchi, to try to fix or improve these lathes, but without success.

Results:

[16] Mr. Predoiu had been engaged by both A&D and Tacchi to provide a neutral view as to deficiencies respecting the three Tacchi lathes. He had concluded they were unfixable, so as to be able to meet the demandingly tight tolerance requirements of A&D’s major customer, GE. Consequently A&D per Mr. Derbedrosian concluded that the Tacchi lathes should be sold, and that A&D should build its own lathes to be able to continue manufacturing large turbine components for GE with heightened tolerance requirements.

Conclusion:

THE JUDGE RULED: INELIGIBLE

[52] A&D in its written submissions made no obvious effort to identify that Tacchi expenditures were included as part of its Project #4 SR&ED claims, or to explain why expenditures respecting the three Tacchi lathes would qualify for SR&ED tax benefits. In A&D’s written submissions, under the heading “ISSUES”, para. 408 reads: “The only issue is whether A&D’s design, development and assembly of the Matteos and Grinding machine constitutes SR&ED…”. Para. 409’s beginning sentence reads basically the same - “Only the Matteos and Grinding machine are at issue.” There is no mention of the Tacchi lathes.

[53] Accordingly, A&D’s SR&ED claim for its 2006 fiscal period pertaining to the three Tacchi lathes (subsumed within A&D’s Project #4), is denied.

Activity #1-2: Design 80 ton lathe (Fiscal Year 2007)

Methods of experimentation:

[19] A&D asserts that the 80 ton Matteo is made up of various systems and subsystems that all had to work together. A&D further submits (written submissions, para. 145) that the major subsystems of the Matteos are the headstock, tailstock, chuck, the cutting tool post on the cross slide (x-axis), the carriage on the longitudinal slide (z-axis) and the tailstock sensor control.

[20] My understanding is that these are usual components of a horizontal lathe.

[21] In more detail, the 80 ton Matteo’s workpiece positioning and driving system included the following elements which A&D describes (written submissions, para. 149) as subsystems - said to be the main spindle and bearings (which holds the workpiece), the main spindle drive system (which provides torqueand speed to the main spindle), the headstock (which supports the main spindle drive system), the tailstock mechanism (which holds the other end of the workpiece in place while allowing for rotation), the tailstock structure (which supports the tailstock mechanism), the hydraulic system (which releases the tailstock locking mechanism), the workpiece bed-ways (which particularly includes the longitudinal guide along which the tailstock moves), the chuck (which holds the workpiece and allows it to rotate with the spindle) and steady rests (providing supplementary support to heavy parts).

[22] A further claimed system of the 80 ton Matteo is the tool positioning and driving system, also said to be comprised of subsystems; such subsystems including the longitudinal carriage guide (which guides the cutting tool carriage as it moves along the z-axis), the longitudinal feed mechanism (which moves the cutting tool carriage along the z-axis), the transversal carriage and guide (which guides and drives the tool carriage along the x-axis), the tool positioning system (which allows multiple tools to be used on the workpiece), the carriage bed (which supports the wheel spindle) and the lubrications system (which lubricates housings for the linear guideways and ball screws).

[23] The third of the three identified systems for the horizontal lathe is the CNC/PLC system. CNC means, as noted, “computer numerical control” and PLC means “programmable logic controller”. This system provides computer control in the operation of the lathe - which system A&D submits includes electronics, Siemens computer and software (A&D written submissions, heading of para. 248).

[24] Mr. Predoiu made calculations and closely directed and oversaw the assembly of the parts, largely purchased “off-the-shelf”, comprising the 80 ton Matteo. A testing start-up regimen for new machines such as this was closely followed, starting and proving one component at a time (an inadequate summary of the start-up regimen).

Results:

REGARDING THE DOCUMENTATION THE JUDGE COMMENTED:

[65] The third of the five Northwest Hydraulic criteria is, did the procedure adopted in each project accord with the total discipline of the scientific method including the formulation, testing and modification of hypotheses? In this matter we have in evidence many drawings made under Mr. Predoiu’s direction of many significant parts of the 80 ton Matteo. We do have fewer items of evidence exhibiting the engineering calculations Mr. Predoiu would have carried out in designing the 80 ton Matteo. What we have - in large part the drawings - helps to corroborate Mr. Predoiu’s testimony that the procedure in developing this machine did accord with the total discipline of the scientific method.

[68] In the case of the 80 ton Matteo records were kept, as noted above largely in the form of drawings of many if not most significant parts of this machine. The parts were in large part designed in the basis of engineering calculations carried out by Mr. Predoiu. Testing only occurred relatively at the end of the building process but that is an aspect of the financial unfeasibility of constructing and utilizing prototypes as above noted. It is acknowledged that not many records pertaining to the carrying out of the testing protocol itself were made, let alone retained.

Conclusion:

THE JUDGE RULED: 100% ELIGIBLE

[62] In my view, considering the evidence as a whole and as well the submissions of the respective parties and experts, A&D in determining to manufacture the 80 ton Matteo did face a technological uncertainty, being system uncertainty. Here A&D, with the specific guidance and expertise of Mr. Predoiu, took known technologies for the manufacture of horizontal lathes and combined with these technologies other known technologies pertaining to using welded structuring rather than cast iron, and other technological innovations as noted above to address inertia and deflection. These adaptations were made necessary by, and made in the unique context of, the intended great size and weight of the workpieces that would be tooled on this lathe, while seeking also the ability to machine very large workpieces with notably extreme accuracy.

[69] In sum, I am persuaded that the Northwest Hydraulic criteria have been sufficiently met that I can conclude that the work that went into design and build of the 80 ton Matteo was SR&ED qualified work. Thus the SR&ED ITCs claimed in respect of this work for Project #4 for the 2007 fiscal period should be entirely allowed A&D.

Significant variables addressed: methods to control inertia & deflection, welded vs cast iron structure

Documentation:

Offline Documents: Docs

Activity #1-3: Design 80, 60 & 40 ton lathes (Fiscal Year 2008)

Methods of experimentation:

[25] Subsequently the 60 and 40 ton Matteos were built. As suggested by the names, they were intended respectively to be able to handle workpieces of up to 60 tons and 40 tons. Unlike the 80 ton Matteo they were constructed of cast iron rather than welded steel. A&D had discovered a foundry in China that could do the iron castings of the carriage bed, workpiece bed, headstock and tailstock. Other differences were use of a different type of off-the-shelf spindle bearings, and use of a ball screw instead of rack and pinion for movement along the z-axis, as the length of that axis was shorter than that for the 80 ton Matteo. Additional calculations were required of Mr. Perdoiu to aid in ensuring these changes were workable. Ultimately the 60 and 40 ton Matteo lathes were successfully commissioned and put to work fashioning smaller workpieces for GE and other A&D customers.

[26] At para. 276 of its written submissions A&D asserts that the 80 ton Matteo was a new machine not available from traditional machine tool suppliers. The same claim is not asserted regarding the 60 and 40 ton Matteos.

Results:

COST ALLOCATIONS BY COURTS : 1/3 EACH MACHINE

[72] In the absence of any allocation from A&D respecting the three Matteos for A&D’s 2008 fiscal period, I will allocate for each of the three Matteos a share of one-third of the total SR&ED

[73] As for the 60 ton and 40 ton Matteos, to my mind the evidence shows that there was little originality factored into their designs and manufacture as distinguished from the case of the 80 ton Matteo. One difference the two smaller lathes had with the 80 ton Matteo was that they were made from cast iron rather than, in the case of the 80 ton Matteo, welded steel. But, as A&D acknowledges in its written submissions at para. 207, in describing notable differences of the 80 ton Matteo, "most machine manufacturers use cast iron for the main components, as cast iron has density that lessens vibration while steel does not."

[75] Another difference cited by A&D in written submissions between the 60 and 40 ton Matteos on the one hand the 80 ton Matteo on the other is that the latter used SKF main spindle bearings while the two smaller machines each used Timken bearings, being “more economical and off the shelf”. (A&D written submissions para. 266). This does not seem revolutionary either.

[76] The third and final difference between the 80 ton and the 60 and 40 ton Matteos cited in A&D’s written submissions (paras. 269ff) is the use of a ball screw drive for the for the z-axis of the two smaller machines rather than, as in the case of the 80 ton Matteo, use of a rack and pinion for movement along the z-axis.

[77] Again, A&D appears to acknowledge that a ball screw drive was already conventional.

Conclusion:

THE JUDGE RULED: 1/3 ELIGIBLE

[80] Thus, I conclude that the work in developing the 60 and 40 ton Matteos did not constitute SR&ED. Consequently, the claim for two-thirds of the ITCs claimed for Project #4 for the 2008 fiscal period, is dismissed. The one-third share of claimed ITCs allocated to work on the 80 ton Matteo in the 2008 fiscal period will be allowed, as previously noted.

Significant variables addressed: methods to control inertia & deflection, welded vs cast iron structure

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Cost ($)	(not set)	(not set)	No
Accuracy (thou)	(not set)	(not set)	No

This project example is based on the Tax Court of Canada case of A & D PRECISION LIMITED vs. THE QUEEN Citation: 2019TCC48

The claimed SR&ED current expenditures are for the 2006, 2007 and 2008 fiscal periods with total federal ITCs of $1,212,213 across 2 projects.

[30] All of the Project #6 work claimed by A&D for each of its 2006, 2007 and 2008 fiscal periods relates to design and ultimately abandoned development of this one machine, called a “double wheel roll grinding machine” (Exhibit R-15).

[31] The novel concept, advanced by Mr. Derbedrosian, was to have the grinding head capable of being moved to either side of the middle of the workpiece for grinding. Removing and repositioning the workpiece could take 16 to 18 hours and realignment could occur. A&D knew of no other grinding machine in the world that could do this. The machine would not grind the workpiece on opposite sides of the middle of the workpiece simultaneously. But there were covers on opposite sides of what would be the middle of the particular workpiece for the two positions the grinding wheel could be moved to.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility
Key Employees:	George Predoiu (mechanical - BASc. (1970) / PEng.), Tony Derbedrosian (Metal forming - Machinist (1974) / President)
Evidence types:	Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Design, system architecture and source code; Records of trial runs; Contracts

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[83] A&D submits that the technical risk or uncertainty in respect of the double wheel grinding machine was whether - with this novel design of having the grinding wheel capable of being repositioned from one side of the machine to the other, rather than requiring the workpiece itself to be moved - fine grinding tolerances still could be achieved. System uncertainty is also cited.

Steps to define prior art:

[33] Before deciding that A&D would build this, Mr. Derbedrosian consulted with Toshiba in Japan about whether it could build such a machine. Toshiba ultimately responded with a $6 million quote to produce such a machine but without guarantee that it could meet the required tolerances.

THE JUDGE COMMENTED:

[84] There was no knowledge, within Canada or internationally, of any grinding machine having this fundamentally novel design feature.

[85] In considering the evidence as a whole, I Conclude that there was not reasonable expectation that routine engineering

or standard procedures would establish that such a design still could achieve required grinding tolerances, defeating risks or uncertainties pertaining to excessive vibration or “chatter”.

The most significant underlying key variables are:

method to move wheel, preventing spindle overheating, vibration control methods

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	20 Articles	search performed - ideally would be detailed
Queries to experts	1 responses	Toshiba Japan quoted $6 million but would not guarantee performance

Activity #1-1: 2006 to 2008 development (Fiscal Year 2006)

Methods of experimentation:

[35] Messrs. Predoiu and Derbedrosian developed specifications for the contemplated machine, including respecting headstock, carriage, wheel head and grinding performance. Again A&D views this complete machine as an assembly of systems and subsystems. And of course to meet GE specified tolerances all systems and subsystems had to well work together (A&D’s written representations, para. 302).

[36] The machine itself was built in part from re-furbishment of an older grinding machine located in Romania. Because the grinding wheel could be repositioned at either end, the traditional set-up of a grinder - wheel at one end and a pulley at the other could not be utilized. A&D envisaged driving the wheel (which could be moved to either side of the middle) from the middle of the machine using a Siemens motor. From the middle of the machine between the two wheel locations, the motor would drive the drive shaft, and the drive shaft would drive the main spindle (A&D’s written representations, para. 303).

[37] There were some novel aspects in the preparation of this machine. To help the spindle not overheat A&D used angular contact bearings that were ceramic which does not overheat, and used Kluber grease, also because ceramic does not overheat (representations, para. 306).

[38] A&D chose to fabricate rather than cast the wheel-bed of the grinding machine. A&D fabricated rather than cast the parts because this was more economical (representations, para. 307).

[39] To help minimize vibration the z-axis carriage traveled on linear guideways like the 80 ton Matteo. This was not typical and may have been the first grinder to use linear guideways. Also the foundation of the grinding machine was stiffened, again seek to minimize vibration.

[40] Further, a steady rest was designed by Mr. Derbedrosian for the grinder, to aid in eliminating or minimizing vibration.

[41] Nevertheless, there was excessive vibration when the machine was tested. Further attempts to minimize vibration (through use of optimizing software to try to isolate the vibration source, and use of vibration measuring equipment, and referral to a vibration analysis company which provided a report) were not sufficiently successful to make the machine acceptable for use. Mr. Derbedrosian decided A&D would not continue development of this machine because of the financial costs that would continue to be incurred.

Results:

THE JUDGE COMMENTED:

[88] Again, Mr. Predoiu’s testimony satisfied me that his highly knowledgeable and experienced input in his position as chief engineer in the design and manufacture of the double wheel grinder was quite focused on reducing risks. That is, he in combination with Mr. Derbedrosian did formulate theories and or plans seeking to minimize anticipated risks pertaining to vibration.

Conclusion:

THE JUDGE RULED: ELIGIBLE

[85] In considering the evidence as a whole, I conclude that there was not reasonable expectation that routine engineering or standard procedures would establish that such a design still could achieve required grinding tolerances, defeating risks or uncertainties pertaining to excessive vibration or “chatter”.

[86] Thus I find that there was technical uncertainty associated with the development and potential implementation of this

radical design concept.

[94] .. I conclude that the work that went into design and build of the grinding machine was SR&ED qualified during each of the subject three fiscal periods.

Significant variables addressed: method to move wheel, preventing spindle overheating, vibration control methods

Documentation:

- Offline Documents: Doc

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Accuracy of data (%)	(not set)	(not set)	No
Autonomous system (1=yes / 0= no)	0	1	No
General purpose equipment (1=yes / 0=no)	0	1	No
Distributed data (1=yes / 0=no)	0	1	No

This project is based on the Tax Court of Canada judgment for CRL Engineering Ltd. v. The Queen (2019 TCC 65).

[13] The Appellant is an engineering firm specialized in developing public transit related technology. It was incorporated in September 2009.

[14] Dr. Raman Paranjape, the Appellant's Chief Executive Officer, testified at the hearing. He holds a Ph.D. in engineering and is a professor of Electric Systems Engineering at the University of Regina. The Appellant's Chief Operating Officer, Craig M. Gelowitz, also holds a Ph.D. in engineering. He was present throughout the hearing but did not testify.

[15] The Appellant commenced its SRED activities as early as 2010 and it was ongoing during the subject taxation years. The Appellant described it as "A Real Time Vehicle Arrival Prediction Model for Transitlive" (the "Project"). It was intended to develop the Appellant's web based system using algorithms and a global positioning system ("GPS") data to provide accurate real time for public transit buses.

Field of Science/Technology:

Computer sciences (1.02.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Dr. Raman Paranjape (Electrical Engineering - PhD (1985) / CEO)
Evidence types:	Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Design, system architecture and source code

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[16] The Appellant argued that the Project involved "developing a physically distributed, multi-computing platform using general purpose computing systems to create, communicate, integrate, analyse and report real-time, dynamic data to users of the transit systems and administrators" and that the technological uncertainty was whether "autonomous computational systems based on general-purpose computing units could be effectively deployed in order to provide accurate and real-time status information to both users and administrators in real-world transit systems". It was argued that the use of "general purpose computing systems" for that purpose is what "creates real scientific uncertainty."

[17] The Respondent (CRA) argues that there was no scientific uncertainty and that the Project involved the use of existing technology, notably Global Positioning Systems or "GPS", and routine engineering or, as described in paragraph (f) of the definition "routine testing of materials, devices, products or processes".

[21] The Appellant described what it called its "over-arching hypothesis" as whether "autonomous distributed computing systems based on general purposes computing units [can] be effectively deployed in order to provide accurate real-time status information to both users and administrators in a real world transit system". The Respondent argues that the Project involved a series of unrelated and un-connected tasks and that there was no real hypothesis.

[22] While the hypothesis appears to be phrased more as a question than an assumption, I find that the Appellant had a "logical plan devised to observe and resolve the hypothetical problem" and that, as such, this criterion is satisfied.

The most significant underlying key variables are:

characteristics physically distributed GP equip (unresolved), use of autonomous system (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Development (Fiscal Year 2020)

Methods of experimentation:

Method	Experimentation Performed
Trials:	10 runs / samples
Other methods:	67000 lines of code

[23] The Appellant indicates that it installed and monitored “a set of computing units on transit vehicles (…) to examine how the system could function” and included various iterations of a code to test some aspect of the operating system that was “regularly updated to evaluate sequentially and progressively more complex options (...) and to examine alternatives”. The Appellant argues that the activities constituted a “progressive and systematic investigation” including adjustments to the sub hypothesis, followed by new testing and documentation.

Results:

Were detailed records kept as the work progressed? THE JUDGE COMMENTED:

[30] The Appellant’s witness explained that “system snapshots were captured on a weekly basis and maintained in a document repository” that were accessible and regularly reviewed. It also maintained a “wiki” that was used to “log data, methods, issues and results”. The documentary evidence, notably Exhibits A 1 and A 3, supported Dr. Paranjape’s oral testimony on this issue.

[31] On balance, I find that the Appellant has satisfied this criterion.

Conclusion:

[26] The Appellant argued that its activities were “focused on understanding the nature and characteristics of physically distributed general purpose multi-computing systems in a hostile and challenging environment”. Its results were reported in a scholarly journal (Exhibit A-2) though the Appellant conceded that its research activities were ongoing. It argued that its research provided a “launching pad for new achievements in distributed computing”.

AS A RESULT THE JUDGE RULED:

[32] On the basis of the documentary and testimonial evidence adduced at the hearing, the Court finds that the Appellant has satisfied the five-factor test described in the case law and that it was engaged in SRED activities during the subject taxation years.

Documentation:

Offline Documents: weekly system snapshots

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Durability (x)	(not set)	(not set)	No
air (x)	(not set)	(not set)	No
slump (x)	(not set)	(not set)	No
temperature (x)	(not set)	(not set)	No
density / compression) (x)	(not set)	(not set)	No

The case examined 14 specific projects over a period of 3 taxation years. Ultimately 6 of these projects were found to be eligible

[71] Exhibit AI-1, which is a table detailing the expenses incurred in respect of each project.

[415] [THE JUDGE] I conclude that the activities carried out by BMQ in the context of projects B 10 18, B 11 04, B 11 07, B 12 01, B 12 03 and B 12 07 are SR&ED activities.

7) Project B-10-18: Develop a light self-compacting mortar for mobile concrete mixer
9) Project B-11-04: Analysis of the influence of binders and additives on the performance of self-placing concrete
10) Project B-11-07: Developing an ultra-fast setting mortar for installation in a marine environment
11) Project B-12-01: Development of fast-setting latex-free concrete
13) Project B-12-03: Development of quick-setting latex concrete screed
14) Project B-12-07: Development of repair product for roller compacted concrete

[6] Mr. Jacques Bertrand testified at the hearing. He is an engineer and also one of the founders of BMQ; he was president of BMQ at the relevant times. Gérard Dubé, engineer at BMQ, also testified at the hearing.

[7] The Canada Revenue Agency ("CRA") research and technology advisers ("CRT") , namely Mr. Cédric Durban, who examined the projects for the 2010 taxation year, and Mr. Karim Mimoune, who reviewed projects for the 2011 and 2012 taxation years, also testified. Mr. Durban obtained a doctorate in mechanical engineering in 1997. Mr. Durban began his career as a private consultant in SR&ED; in 2009, he joined the CRA and was working as a CRT with the CRA at the time of the audit. Mr. Mimoune holds a doctorate in mechanical engineering and has worked as CRT at the ARC since 2002.

A. EVIDENCE - CONTEXT OF PROJECTS
1) Business operated by BMQ
[10] Mr. Bertrand is an engineer by training and has been practicing this profession since 1967. He has worked for many years in the field of civil engineering for large projects such as James Bay and Churchill Falls, in which concrete was widely used. He also worked on the construction of the Montreal metro.

[11] Mr. Bertrand and two partners founded BMQ in 1979. Mr. Bertrand testified that at the time, there was a lack of companies capable of meeting the demand for smaller projects, or for more specific projects or for repairs.

[12] BMQ operates as a concrete supplier in the field of prepared and specialized concrete. This company is a leader in this field. Its clients are entrepreneurs who work for public or private construction sites. Most of BMQ's turnover comes from contracts in the public sector. Usually, before the awarding of a contract to BMQ, and particularly when a contract is awarded in the public sector, the concrete mixture to be supplied by BMQ to the contractor is pre-approved by the client and by the contractor, since concrete must meet minimum industry standards.

[13] BMQ supplies fresh concrete using mobile concrete mixers and not “drum concrete mixers”or conventional concrete mixers, which allows it to offer its customers innovative solutions and products to meet the various needs of these in the context of the realization and repair of concrete structures.

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:
Work locations:
Key Employees:
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

2) Concrete
[16] Concrete is made up of several inputs: cement, sand, stone and drinking water. Various adjuvants can be added, such as entrained air, superplasticizers, colloidal agents and latex. These additives are added to give concrete certain characteristics, such as better resistance or better durability.

[17] BMQ has the recipes for around 300 concrete mixes and develops 15 to 20 per year. According to Mr. Bertrand, the possible combinations of the various inputs are extremely numerous since there are six or seven cements, 100 types of stones, a very large number of types of sand, and 500 to 1000 different additives. The dosage of each of these inputs can also be subject to variations.

[18] A concrete mixture must meet certain standards to be used on public worksites. For example, standard 3101 of the Specifications and General Specifications of the Ministère des Transports du Québec ("MTQ") must be reached. According to Mr. Bertrand, even when inputs have been known for a long time, the needs of the industry change and BMQ seeks to make new mixtures accordingly. In addition, minimum standards are evolving. Standard 3101 is reviewed annually and CSA (Canadian Standards Association) standards are reviewed every five years. For example, Mr. Bertrand explained that the compressive strength standards went from 35 megapascals to 50 megapascals between the 60s and today. In addition, BMQ does not necessarily limit itself to meeting the standards and may seek to improve products even when they already meet the minimum standards. Each concrete mixture must reach certain thresholds, and around twenty tests must be carried out in the laboratory for the mixture to be approved for use on a public site. These tests are aimed, for example, at checking the compressive strength, the chipping resistance and the permeability to chlorine ions.

[19] In addition, other tests are carried out directly on a site before pouring concrete. These tests are carried out while the concrete is still in the plastic state, that is to say while it is still in liquid form. This is an air test, a slump test and a temperature test, which take about ten minutes to do, and a compression / density test, i.e. taking samples in cylinders, which takes about fifteen minutes to do.

3) Research
[20] Mr. Bertrand testified that BMQ has been doing research and development since the end of the 1980s, either to create new products or to improve existing ones. New products are developed either at the request of customers or because industry standards have changed. Sometimes a project can be launched directly by the company, because it always seeks to remain competitive. Both Mr. Bertrand and Mr. Dubé and also Mr. Fournier (the master mechanic of BMQ) can decide to start a project.

[21] With regard to the approach followed by BMQ in the context of the various projects, Mr. Bertrand explained that the company works regularly with the MTQ and various universities. The starting point for a project is usually bibliographic research and discussions with colleagues, industry and university professors. However, the results of studies carried out in places like the United States are not necessarily directly transferable to Quebec, where winter must be taken into account to determine if a concrete is durable; Also, it must be taken into account that the concrete mixture is prepared in a mobile concrete mixer. Then, the hypotheses are fixed: for Mr. Bertrand, the hypotheses are the characteristics sought in a mixture, or, according to Mr. Dubé,

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	20 sites / articles	

Patent searches	2 patents
Competitive products or processes	3 products
Similar prior in-house technologies	1 products / processes
Suppliers	3 products
Queries to experts	4 responses

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

The case involved examination of 14 separate projects. 6 were deemed eligible & 8 ineligible.

We will examine the successful projects independently in projects 2011-2017.

OVERVIEW OF RESEARCH METHODOLOGY

[22] Subsequently, BMQ begins to test and continues the project if it looks promising after the first tests. BMQ has a laboratory with equipment - such as a balance, sagging cones, an air meter, cylinders, a washing tub, a cold room and a small mixer - to do certain tests. In the laboratory, the concrete is prepared as in a conventional concrete mixer. If a mixture is satisfactory, it must then be checked whether the results are similar when the mixture is produced in the mobile concrete mixer and whether the mixture meets the standards. BMQ uses its own concrete mixers to do this. Durability tests, like those of compressive strength, are carried out by independent laboratories.

[23] The direction research will take will then depend on the characteristics sought. For example, a specific adjuvant can be considered at the start of a project to achieve a certain standard. Mr. Dubé explained that, despite his expertise, he does not always find the solution to a problem on the first try. In addition, BMQ must redo the standard tests (air, slump, temperature and density / compression) to check if the standards are always met each time an element is modified in a mixture.

[24] Two stages must be successfully completed for a mixture to be satisfactory for BMQ. First, the standard air, slump, temperature, and density / compression (cylinder) tests are done in the laboratory; if the results are acceptable, this will be followed by chlorine ion permeability tests, chipping tests and freeze-thaw tests. If at the first stage the results are not satisfactory, BMQ will try to determine the causes and reformulate the mixture to then repeat the tests.

[25] The second step consists in calibrating the mobile concrete mixer and pouring the mixture to carry out the same tests again to ensure that the mixing in the mobile concrete mixer has not affected the characteristics of the mixture. According to Mr. Dubé, three people are required to carry out a test: a mobile concrete mixer operator, a technician qualified for taking samples and himself. Mr. Dubé testified that it took approximately two to three hours to calibrate the mobile concrete mixer.

[26] The analysis of the results is largely carried out by Mr. Bertrand and Mr. Dubé. A meeting with the employees involved in a project, including the technicians who operate the mobile concrete mixer and take samples, is convened when test results are received by the company, because these employees can have an idea about the causes of the failure of a test and must be made aware of the progress of a project.

[27] A project ends either when the objective is reached, or if the objective is not reached and no solution is envisaged to overcome the difficulties.

Results:

i) For the taxation year ending January 31, 2010: $ 3,521 for salaries, $ 427 for materials and $ 360 for costs of subcontractors;

ii) For the taxation year ending January 31, 2011: $ 37,668 for salaries, $ 2,520 for materials and $ 3,425 for costs of subcontractors;

iii) For the taxation year ending January 31, 2012: $ 44,192 for salaries, $ 4,433 for materials and $ 9,204 for subcontractor costs.

DOCUMENTATION:
[28] No report is written at the end of each project. However, Mr. Dubé completes Form T661 Request for Scientific Research and Experimental Development Expenses (“Form T661”) and submits it to the CRA. This form contains a description of the progress that BMQ has attempted to achieve, the obstacles that had to be overcome and the steps taken to implement a project.

[29] Mr. Bertrand explained that, during the years in dispute, he was personally involved in research activities with regard to the conception, design and development of research plans and that he attended conferences related to projects. He also personally participated in field tests, in laboratory at BMQ, as well as in universities.

[30] With regard to expenses, Mr. Dubé testified that, generally, the date, time and a brief description of the tests carried out within the framework of a project are noted in a notebook. Mr. Dubé admits that the notes kept will not necessarily be understandable for another civil engineer, but he is able to understand them and consult his computer files to determine what was done in a project.

[31] Each month, documents relating to a project, such as handwritten notes and emails, are given by the employees to Mr. Dubé, who compiles the hours of work spent on each project in BMQ's computer system. Only employees paid according to hours worked fill out time sheets, which excludes Mr. Bertrand, Mr. Dubé and Mr. Fournier. To calculate the hours spent working on a research project, Mr. Bertrand indicates the time he has spent on a project and gives it to Mr. Dubé, who compiles the hours. Mr. Dubé testified at the hearing that he rounded up the hours indicated on the time sheets.

TIMING OF EVENTS:

DATES OF THE HEARING: April 8, 9, 10, 11 and 12 and May 29, 30 and 31, 2019

REASONS FOR JUDGMENT BY: The Honorable Justice Dominique Lafleur

DATE OF JUDGMENT: December 11, 2019

Conclusion:

Project Details:

Scientific or Technological Objectives:

[213] This project is an attempt by BMQ to develop a light self-compacting mortar for mobile concrete mixers. This product was already existing for conventional concrete mixers. However, given the greater flexibility of the mobile concrete mixer, a BMQ client requested that the company develop such a product for mobile concrete mixer. BMQ therefore had to develop a mortar that could be poured between existing storm sewer pipes and new pipes, without deforming them.

[214] Mortar differs from concrete in that it does not contain stones. The term "self-compacting" implies great fluidity - that is, the ability to spread by the sole effect of gravity - while the term "light" means low density, i.e. a high air content in The mixture. The air content sought for the mixture in the context of this project was 20%, but it was also necessary that the resistance of the mortar to compression be at least 20 megapascals.

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Develop new processes
Work locations:	Research Facility
Key Employees:	
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[220] In the event that the activities carried out by BMQ in the context of this project are qualified as SR&ED activities, the parties' disagreement would only remain with regard to the salaries for which the deduction is claimed by BMQ, which total 1,710 $ and relate essentially to the 34 hours devoted to bibliographic research to find foaming products and equipment as well as to certain discussions between Mr. Bertrand and Mr. Dubé for the development of mixtures, which took place between November 7 and 20 November 2009. The Respondent agrees that amounts totaling $ 2,202 for salaries, $ 427 for materials and $ 360 for costs of subcontractors would be deductible expenses under section 37 and eligible for the calculation of the ITC.

7.2 The parties' submissions
[221] According to the appellant, the existing products and equipment were not designed for the mobile concrete mixer. The uncertainty consisted in the absence of existing data on the ability of the mobile concrete mixer to produce the mortar in question and in the absence of foaming equipment that would be suitable for the mobile concrete mixer. The work enabled BMQ to acquire new knowledge on the limits regarding the capacity of foaming additives and a mobile concrete mixer to produce mixtures with high air content. The project also made it possible to determine that the source of these limits was the mixing process of the mobile concrete mixer. These activities therefore constitute SR&ED activities since they can be qualified as experimental development work undertaken in the interest of technological progress.

[222] According to the respondent, the activities carried out by BMQ cannot be qualified as SR&ED since the whole does not seem complicated. In fact, in less than three weeks, the equipment was designed and the mixture was produced. According to Mr. Durban, BMQ has not deviated from standard methods by using a foaming adjuvant and an air entraining adjuvant whose characteristics precisely consist in generating air in a mixture. Adding air with this equipment designed to add air also had a predictable result, which was to increase the air content.

THE JUDGE RULED
[224] The evidence showed, on a balance of probabilities, that technological uncertainty was present in the case of this project. BMQ was unable to predict whether the generally available experience or knowledge or current practices would meet the criteria required by its client. The objectives set by the client were achievable by using a conventional concrete mixer, but it was impossible for BMQ to predict whether they would be achieved by means of the mobile concrete mixer. Uncertainty existed with respect to the manufacture of a very light mortar product with 20% air that can be installed in storm sewer lines without distorting the old lines. The evidence showed that no data existed regarding the ability of the mobile concrete mixer to produce such mortar.

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

[216] BMQ tested several mixtures by trying to successively modify the adjuvants (air entrainer and foaming agent existing on the market) and the cement content of a standard mortar mixture. Air content, temperature, spreading and compressive strength tests were performed on the mixtures as part of this project. Test results demonstrated an air content ranging from 12% to 15%; these results were therefore below the criteria required by the client.

[217] Faced with these unsuccessful tests, BMQ employees worked on the design of equipment to further foam the mixture by injecting compressed air. They were inspired by equipment designed for conventional concrete mixers but which could not be installed on a mobile concrete mixer. BMQ has repeated the tests, but without more success.

Results:

[218] The project was unsuccessful since BMQ failed to obtain an air content of 20% for the mixture. In fact, despite the adjustments to the mixture and the use of the equipment designed by the two BMQ employees, it was not possible to increase the air content of the mixture.

[219] To date, the product that BMQ has attempted to design still does not exist. This project has not been resumed since that time.

Conclusion:

THE JUDGE CONCLUDED

[225] BMQ also sought technological progress, although it was unable to meet the criteria required by its client. Indeed, progress would have consisted in the incorporation in a mixture of mortar produced by means of a mobile concrete mixer of a characteristic, that is the air content of 20%, difficult, if not impossible, until then, to reach in current practice. The fact that this project did not provide the desired product does not exclude the activities from the definition of SR&ED activities. As indicated by Mr. Dubé, BMQ has acquired certain knowledge regarding the limit of the mixing energy of the mobile concrete mixer and the effects of the limited mixing time of the latter on concrete / mortar mixtures.

[226] According to the respondent, given that BMQ employees took only a few hours to adapt equipment designed for conventional concrete mixers to the mobile concrete mixer, this could not be so complicated, and that this indicates that the activities cannot be qualified. SR&ED activities. I do not see how the criterion of difficulty or ease in doing something can be relevant for the purposes of qualifying an SR&ED activity. The evidence showed that the two BMQ employees designed equipment for the mobile concrete mixer based on equipment designed for conventional concrete mixers. These employees could not adapt the equipment designed for the conventional concrete mixer directly to the mobile concrete mixer; thus, I conclude that these activities are not part of current practice.

[227] The evidence also showed that Mr. Dubé systematically studied the problem raised by the low percentage of air in the mixtures tested and did some experimentation to determine the causes of these results. Tests have been performed by an independent laboratory. The assumption was made that the addition of a foaming aid and an air entraining aid and the injection of air would increase the air content of the mortar mixture. I consider that the scientific method was followed by BMQ. Although there was no detailed contemporary account of the tests, the documentation produced at the hearing and the testimonial evidence, particularly the testimony of Mr. Dubé, made it possible to detail the activities undertaken within the framework of this project .

[228] For these reasons, the activities carried out by BMQ in the context of this project constitute SR&ED activities.

Project Details:

Scientific or Technological Objectives:

10.1 Description of the project
[286] This project started when BMQ received a request from a client for a cement mixture based on ultra-rapid cement to be used to seal rock underwater and used as a bridge pillar. A mortar mixture intended to be installed underwater has the characteristic of containing an anti-leaching additive so that it holds in place without diluting. The client demanded that the setting of the mortar be very rapid in order to be able to start work the day after the laying of the mortar, while a waiting period of 21 days after laying is normally necessary.

[287] The component of activities preceding September 8, 2010 is no longer the subject of a claim for deduction for expenses relating to SR&ED activities. The aim of these activities was to improve the air content of certain mixtures, without affecting the properties of the mixture. However, at the hearing, BMQ agreed that the claim for SR&ED expense deduction would only apply to activities that began on September 8, 2010 with the formulation of a new quick-setting anti-leaching mortar mixture, which ended on October 27, 2010.

[288] In order for the mortar to set quickly, BMQ had to add an accelerating adjuvant to its mixture. According to the timesheets produced in evidence, the superplasticizer adjuvant was also modified to improve the air content of the mixture. This formulation was tested at BMQ in order to check if the mortar could be poured using a mobile concrete mixer and would spread well in the cavities of the rock. Samples taken during this test showed that the addition of the superplasticizer adjuvant negatively affected the compressive strength of the mixture at an early age.

[289] Several reformulations took place following the test in order to optimize the air content as well as the resistance of the mixture to compression. BMQ succeeded in creating the desired mixture and the client was able to carry out their project with the mortar recipe created by BMQ.

[290] In the event that the activities carried out by BMQ in the context of this project are qualified as SR&ED activities, the parties' disagreement would only remain with regard to salary expenditures totaling $ 1,390, including the deduction is claimed by BMQ and subcontractor costs totaling $ 1,917. The respondent agrees that amounts of $ 1,920 for salaries and $ 394 for materials would be expenses deductible under section 37 and eligible for the calculation of the ITC.

Field of Science/Technology:

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[291] According to the appellant, the project enabled BMQ to create a new product, which did not previously exist. This product being non-existent, there was no data on this subject. In his analysis, Mr. Mimoune failed to consider the need to place the mortar underwater. These activities therefore consist of SR&ED activities since they constitute experimental development work undertaken in the interest of technological progress.

[292] According to the respondent, the activities cannot be classified as SR&ED since this project does not reveal any technological uncertainty. According to Mr. Mimoune, the work was carried out using basic knowledge in the field. Thus, if a setting accelerator is used (as for quick-setting mortars), it is clear that the air content of the mixture will be lower and that it will therefore be necessary to compensate with an adjuvant which promotes the creation of air bubbles . Also, large-scale tests were carried out the week following the development of the mixture, which demonstrates the absence of technological uncertainty.

[295] However, the evidence also showed that BMQ knew that the addition of an accelerator would have a negative impact on the air content of a mixture. This is what emerges from the introduction to the project, which can be found on form T661: "The objectives of this project are to optimize and obtain robustness in the air content of concrete mixtures fast. The presence of setting accelerator in an air-entrained concrete formulation significantly influences the air content as well as the network of air bubbles. "Also, according to this form, in order to optimize certain mixtures, certain adjuvants had to be replaced by other adjuvants; this replacement of superplasticizing adjuvants by other superplasticizing adjuvants included certain factors of uncertainty which led to certain dosages having to be re-evaluated. Likewise, Mr. Bertrand indicated that BMQ had used quick-setting cement since 2001 and that it had been used in the United States since the 1990s.

[296] But although BMQ used current technological knowledge or current practices to create the new product in this project, BMQ could not predict whether the objectives could be achieved, or at least BMQ could be fairly convinced of achieving them. , but without knowing with certainty which solution would be applicable. The uncertainty concerned the creation of a product allowing installation underwater and containing an anti-leaching adjuvant so that the product held in place without diluting, and which would be taken very quickly. This project is not a product development since the evidence has shown that such a product does not exist, and it is not about data collection since only activities that started on September 8, 2010.

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

[293] In the case of this project, BMQ succeeded in demonstrating that, on the balance of probabilities, there was a technological uncertainty raised by the requests of its client.

[294] In the present case, the evidence demonstrated that this project resulted in the creation of a new product (907 mix), namely the quick-setting anti-leaching mortar; this product did not exist on the market before.

[297] Also, scientific progress in this case consists in advancing BMQ's knowledge of the various dosages and properties of the inputs used. In particular, BMQ learned that the new superplasticizer adjuvant affected the early compressive strength of its mixture and BMQ eliminated some dosing possibilities for the adjuvants tested to arrive at a solution.

[298] The fact that only one week has passed between the formulation of the mixture and the start of the tests does not in any way demonstrate the absence of technological uncertainty.

Results:

[300] As in the case of the other projects, BMQ's tests can partially be reconstructed using its documentation, but a report compiling the tests and making it possible to follow BMQ's thinking throughout the project did not been done. However, even if BMQ did not prepare a detailed account contemporaneously with the tests, the documentation produced at the hearing and the testimonial evidence, particularly the testimony of Mr. Bertrand, demonstrated the progress of the activities.

[306] The total expenses deductible under section 37 and eligible for the calculation of the ITC for salaries is therefore $ 2,979

Conclusion:

[299] BMQ demonstrated that, as part of this project, it had hypothesized that the air content of its mixture would be improved by modifying the superplasticizer adjuvant and that resistance at a young age would generally be improved by other modifications in the dosage of adjuvants. With regard to the use of the scientific method, I conclude that, since tests have been carried out scientifically and that the modifications made to adjust the dosages have been in reaction to the results obtained, the scientific method has been followed.

[300] As in the case of the other projects, BMQ's tests can partially be reconstructed using its documentation, but a report compiling the tests and making it possible to follow BMQ's thinking throughout the project did not been done. However, even if BMQ did not prepare a detailed account contemporaneously with the tests, the documentation produced at the hearing and the testimonial evidence, particularly the testimony of Mr. Bertrand, demonstrated the progress of the activities.

[301] Thus, for these reasons, the activities carried out by BMQ in the context of this project constitute SR&ED activities.

Project Details:

Scientific or Technological Objectives:

[387] This project is a continuation of the BMQ parking lot covering project. Roller compacted concrete or BCR is a product that has experienced misfires following its arrival on the market some fifteen years ago. A BCR repair product was available but it was very expensive. According to Mr. Bertrand, BMQ decided to develop a repair product for this type of concrete that could be used for repairs in thin layers as well as in depth.

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Jacques Bertrand (Civil - PEng. (1970) / President)
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[396] According to the appellant, technological uncertainty existed because the only data available on this type of concrete came from California, where the climatic conditions are different and that the mixtures developed had to be compatible with the mobile concrete mixer. Mr. Mimoune misunderstood the project since he does not distinguish BCR as such from repair products for this concrete. The project made it possible to develop promising new products, which we continued to monitor in the years following the year in dispute. These activities therefore constitute SR&ED activities since they can be qualified as experimental development work undertaken in the interest of technological progress.

[397] According to the respondent, the activities cannot be qualified as SR&ED. According to Mr. Mimoune, the mixes had been developed in collaboration with the company that created the cements introduced in the tested mixes, namely CTS Cement. BMQ has neither modified the mixes nor developed new techniques for placing concrete. Repair products were available, and although they had to be adapted for use in the mobile concrete mixer, this is a normal obstacle in the industry. BMQ did not use the scientific method, according to him, since the procedures consisted mainly of consulting experts. Also, the respondent argued that discussions led directly to large-scale tests and that the scientific method was therefore not followed by BMQ. In addition,

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

[388] According to Mr. Bertrand, it is difficult to validate the durability of such a product without putting it to the test under real conditions, which include, for example, the passage of heavy vehicles, because laboratory tests are not enough not always to obtain a faithful representation of a product.

[389] BMQ therefore undertook to test repair products on its own slab made of BCR located in its parking lot. Two strips were dug in the BCR slab of the BMQ parking lot to test the products, that is to say that two small sections of the parking slab were demolished (two feet wide, twenty feet long and different depths, 25 and 125 millimeters respectively). One was demolished by scarification and the other using a jackhammer. Both are located in a part of the BMQ parking lot where heavy trucks regularly pass by to refuel.

[390] More specifically, three mixes of repair concrete were placed on the edges. According to Mr. Bertrand, the mixtures

tested were not "tablet" mixtures . The mixtures were all made of quick setting cement, but had variations in the type of cement and the admixtures used.

[391] The first mixture put in place was a mixture developed by BMQ in the 2000s. It was to serve as a point of comparison for the other two mixes. The second mixture was a self-consolidating concrete containing a type of cement that BMQ had only used for two years, as well as a superplasticizer and a colloidal adjuvant which gave the mixture its self-compacting property. Finally, the third mixture was experimental in nature and had the particularity of containing powdered acrylic latex. This mixture had been tested in the United States and used for the repair of concrete structures in this country. However, the expert consulted by Mr. Bertrand had confirmed that he did not believe that this concrete would perform well in the planned repairs.

[392] The cements used in the second and third mix came from the same supplier, CTS Cement, with whom BMQ planned the implementation of this project.

[393] Samples were taken during the installation of the repair products to check the adhesion by oblique shearing, the network of air bubbles, as well as the resistance to compression. According to Mr. Bertrand, two of the three mixtures can be used to make repairs to the BCR; however, the test mixture from the United States can only be used indoors since it did not meet the standards for durability testing.

[394] BMQ continued to observe the progress of the repairs carried out over the following years. Three years after the end of the tax year in dispute, BMQ has made tensile strength tests on cores taken from the selvedges to verify the adhesion of the mixtures to the concrete slab on which they were laid. . The testing of other repair products combined with different demolition techniques of the BCR slab was also done in the taxation years after the 2012 taxation year.

Results:

COSTS

[412] Thus, the salary expenses for which the deduction is claimed by BMQ should be reduced by a total amount of $ 2,715, representing the salaries for ineligible activities ($ 1,524) and the 10% reduction in expenses ($ 1,191). The total deductible salary expenses under section 37 and eligible for the calculation of the ITC is therefore $ 10,728.

[413] According to the documentary evidence filed at the hearing, the expenses for the materials totaled $ 494, representing the cost of the various mixtures tested within the framework of this project. However, according to Exhibit AR-1, the appellant has waived the right to claim the deduction of costs relating to mobile concrete mixers (that is, the 32 hours during which they were used). Given the concessions made by the parties, the total expenditure for the materials that are deductible under section 37 and eligible for the calculation of the ITC is therefore $ 494.

[414] Expenses related to subcontractors retained to perform laboratory tests are considered expenses for SR&ED activities, being expenses incurred in support of the project and directly related to the SR&ED work. However, the expenses incurred for the excavation of the slab of BCR should not be included as deductible expenses under section 37 and eligible for the calculation of the ITC, these being instead replaced by the replacement amount, since I consider that these expenses do not represent expenses directly related to the SR&ED work. Thus, taking into account the concessions made by the appellant and the exhibits produced, the expense of $ 1,917 for the subcontractors is deductible under section 37 and admissible for the calculation of the ITC

Conclusion:

a) Qualification of the project

[398] In the present case, the evidence demonstrated that relatively new cements were introduced into the mixtures tested and that the performance of the mixtures as BCR repair products was unknown in current industry techniques or practices. A mixture had actually been created by BMQ in 2009 and used to carry out repairs on the Champlain Bridge; another mixture, containing an acrylic latex, was an experimental concrete that had been tested in the United States and used in the repair of certain works in the United States; and another mixture had been used by BMQ since the early 2000s.

I consider that BMQ's objective in this project was to advance the procedures for repairing BCR slabs. The evidence showed that the characteristics of the repair concrete were not fixed at the outset; the objective was precisely to develop a concrete that can be used for repairs in thin layers as well as in depth. We therefore met the criterion of technological progress.

[399] In the present case, BMQ convinced me of the existence of a technological uncertainty in this project, which could not be dissipated by technical studies or usual procedures, since BMQ demonstrated that the probability of reaching the objectives sought were not known or determined in advance according to the technological knowledge usually available. Indeed, no large-scale test had been done to test the new BCR repair materials. BMQ could not therefore rely on technical studies or current practices to dispel this technological uncertainty. More specifically, one of the mixtures had never been tested or used in Quebec.

[400] Also, BMQ used the scientific method in the context of this project, having compared the results of the various mixtures placed under similar conditions; it also posed hypotheses.

DOCUMENTATION

[401] As in the case of the other projects, BMQ's tests can be partially reconstructed using its documentation, but a report compiling the tests and making it possible to follow BMQ's thinking throughout the project did not been done. However, even if BMQ did not prepare a detailed account contemporaneously with the tests, the documentation produced at the hearing and the testimonial evidence, particularly the testimony of Mr. Bertrand, demonstrated the progress of the activities.

RULING

[402] Thus, for these reasons, the activities carried out by BMQ in the context of this project constitute SR&ED activities.

Project Details:

Scientific or Technological Objectives:

Ineligible projects

Field of Science/Technology:

Project Details:

Intended Results:
Work locations:
Key Employees:
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

Results:

THE JUDGE CONCLUDED:

[157] Overall, the activities carried out by BMQ in the context of projects B 10 05, B 10 07 and B 10 08 are the result of a change of supplier of ternary cement. Even if I examine the three projects as a whole, the presence of uncertainty going beyond what is resolvable by current technical studies or usual procedures has not been demonstrated by BMQ on a balance of probabilities. Indeed, I conclude that this is an update or product development carried out through standardized tests and field trials.

Also, the progress described by BMQ, namely the modification of the ternary cement supplied by Holcim, has not been demonstrated convincingly enough to determine whether it is an advancement made by BMQ or by Holcim.

[169] As mentioned in the analysis of project B 10 05, the appellant considers that the characterization activities of a new generation superplasticizer adjuvant must be examined in conjunction with projects B 10 05, B 10 07 and B 10 08. These activities constitute, according to her, SR&ED activities since they constitute experimental development work undertaken in the interest of technological progress.

[170] According to the respondent, the activities carried out by BMQ within the framework of this project are only intended to characterize products and do not demonstrate any uncertainty or any technological progress. The work undertaken by BMQ in the context of this project is standard formulation work and work to assess the performance of existing commercial products, and there has been no obstacle or technological progress in the case of this work. Thus, the activities cannot be qualified as SR&ED activities.

Conclusion:

Project Name:	B-10-12: Development of cavernous concrete with a high vacuum content.	**Start Date:**	2020-05-01
Project Number:	2021	**Completion Date:**	2020-08-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Vacuum content (void %) (%)	30	35	Yes
reduce water run off to city (%)	(not set)	(not set)	No

[178] The activities of this project took place in conjunction with the activities of two other projects, namely project B 10 11 (draining concrete), partially accepted as part of the audit, and project B 10 10 (roller compacted concrete or BCR), rejected at the verification stage. The appellant discontinued appeal regarding this project during the hearing.

[179] The City of Laval, where the BMQ premises are located, has been asking for several years that the company's parking lot be paved. Also, according to the city's requests, the discharge of rainwater into the sewers should be limited.

[180] BMQ therefore undertook to pave part of its land located at the front of its business with two types of concrete, namely BCR and draining concrete, below which BMQ had installed a layer of cavernous concrete comprising a vacuum content of 35%. The cavernous concrete also contains a water drainage system designed by BMQ, a network of perforated drains to collect rainwater. The cavernous concrete underlay installed over the entire surface of the parking lot thus acts as a water retention basin.

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Lab
Key Employees:	Jacques Bertrand (Civil - PEng. (1970) / President)
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

APPELLANT ARGUED:

[187] According to the appellant, the project made it possible to develop cavernous concrete with a vacuum content of 35%, which did not previously exist. This product was created with the aim of retaining water instead of simply letting it flow as it usually did. This project is an integral part of the draining concrete project.

[188] The appellant referred to a report prepared by a doctoral candidate at the University of Waterloo (Vimy Henderson), who undertook the project on draining concrete (Exhibit I 1, tab 8). According to this report, maintaining a vacuum content of 35% in cavernous concrete was essential to this project.

[189] For the appellant, the activities constitute SR&ED activities since they constitute experimental development work undertaken in the interest of technological progress, as well as applied research work undertaken in the interest of advancement science.

CRA ARGUED:

[190] According to the respondent, cavernous concrete is not concrete that can be installed using a mobile concrete mixer. BMQ therefore had no interest in developing such a product.

The vacuum percentage of 35% instead of 30% would have been chosen simply to be able to install a thinner layer and thus reduce costs. In addition, there is no real progress or advancement just because of the increase in the percentage of vacuum content in an existing product.

Also, it is not reasonable to consider the entire BMQ parking lot as a test bed. Only a small part of the cavernous concrete was instrumented, that is to say that installed under the draining concrete, which covers only a small part of the parking lot (15% to 20% of the area). According to Mr. Durban, the purpose of the instrumentation installed in the context of the draining concrete project was to verify the efficiency and behavior of the draining concrete and not that of the cavernous concrete.Instrumentation of cavernous concrete was only necessary to ensure that the passage of water through the draining concrete was properly measured.

Finally, the absence of technological uncertainty is also demonstrated by the fact that the city of Laval accepted the plans provided by an engineer who indicated before the work was even carried out, that the work would meet the water retention requirements of the city, and this engineer also confirmed the conformity of the works after the repair of the parking lot. Thus, the activities cannot be qualified as SR&ED activities.

Instrumentation for cavernous concrete was only necessary to ensure that the passage of water through the draining concrete was properly measured.

The most significant underlying key variables are:

how to achieve vacuum content 35% (unresolved), integration with draining concrete (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	[188] The appellant referred to a report prepared by a doctoral candidate at the University of Waterloo (Vimy Henderson), who undertook the project on draining concrete (Exhibit I 1, tab 8). According to this report, maintaining a vacuum content of 35% in cavernous concrete was essential to this project.

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

Method	Experimentation Performed
Trials:	1 runs / samples
Physical prototypes:	1 samples

[181] Cavernous concrete is a concrete also called “popcorn concrete” because of its very porous appearance. The higher the void percentage of the cavernous concrete, the more it is able to retain a large amount of water. According to Mr. Bertrand, cavernous concrete is a product that existed in the literature, but it was not covered by any standard. However, the void percentage of such concrete was limited and was between 12% and 30%. BMQ has chosen to use cavernous concrete with a void percentage of 35% in order to be able to install a thinner and therefore more economical layer, and in order to be able to retain an equivalent amount of water.

[184] In the context of project B 10 11 (draining concrete), the University of Waterloo installed probes that measured the moisture in the draining concrete; these probes were installed in surface concrete (draining concrete), in cavernous concrete under draining concrete and in loose soil under cavernous concrete. The probes made it possible to measure the percolation of water in these three layers. According to Mr. Bertrand, the surface area of the parking lot used for the purpose of the draining concrete experiment was approximately 3,000 to 4,000 square feet (out of approximately 20,000 square feet).

[185] The excavation of BMQ's land prior to the installation of the concrete was done by subcontractors. BMQ supplied the cavernous concrete, but the concrete and the drainage system were installed by a subcontractor, Demix Construction. This work took place in two phases so as not to hamper BMQ's activities. The first phase took place on July 22 and 23, 2009 and the second phase on August 13, 2009.

Results:

- Vacuum content (void %): 35 % (100% of goal)

[187] According to the appellant, the project made it possible to develop cavernous concrete with a vacuum content of 35%, which did not previously exist. This product was created with the aim of retaining water instead of simply letting it flow as it usually did. This project is an integral part of the draining concrete project.

Conclusion:

RULING & RATIONALE: THE JUDGE CONCLUDED;

[191] BMQ did not convince me that, on a balance of probabilities, there was technological or scientific uncertainty in the case of this project, since the existing scientific or technological knowledge enabled BMQ to achieve the objectives of the project. Similarly, BMQ did not convince me that there had been scientific or technological progress.

[192] The absence of technological or scientific uncertainty is demonstrated by the fact that the parking plan proposed by BMQ was approved by an engineer and by the city of Laval even before the work was undertaken and without any other steps being taken by BMQ. Thus, BMQ had to be convinced that the objectives would be achieved and that the cavernous concrete solution was viable. Also, I conclude that the probability that the objectives sought by BMQ would be achieved was foreseeable in this case, given current industry practices.

[193] In addition, I conclude that the creation of cavernous concrete with a vacuum content of 35% was the result of common industry practices. Mr. Bertrand testified that tests had been carried out to create cavernous concrete at 35%. However, the documentary evidence produced at the hearing does not refer to any test or analysis. Also, on the T661 form it is a question of 30% cavernous concrete. Questioned on this subject at the hearing, Mr. Bertrand indicated that the project had evolved over time. However, this answer is not very plausible since the T661 form is filed with the CRA after the work is completed. In addition, in the report prepared by the doctoral candidate at the University of Waterloo (Vimy Henderson), who undertook the project on draining concrete (Exhibit I 1, tab 8), it is stated that, usually, cavernous concrete has a porosity of 30 to 40%. The evidence did not demonstrate that there was an improvement in the characteristics of the cavernous concrete in this project. Indeed, this product already existed in the industry.

[194] In their arguments, the appellant referred to the report prepared by Vimy Henderson, according to which maintaining a void of 35% in cavernous concrete was essential to this project, to argue that the activities constituted SR&ED activities. However, the passage in question from the report seems to me to speak rather of the fact that the data on the draining concrete could have been distorted by a malfunction of the cavernous concrete and therefore does not support the appellant's argument.

[195] According to BMQ, the progress or advancement in the context of this project consisted in understanding the performance of cavernous concrete when accompanied by other concretes and used in different configurations. On form T661, mention is made of the improvement in the rate of infiltration of rainwater into the original soil, the reduction in the maximum rate and the volume of rainwater sent to the municipal network or, by runoff, to rivers, the installation of a foundation by "paver" so as to allow the installation of cavernous concrete containing 30% vacuum, and the installation of draining concrete, also by "paver". However, the instrumentation installed by the University of Waterloo was intended to measure the permeability of the draining concrete and this instrumentation was only installed in the part of the parking lot whose surface was made of draining concrete, i.e. from 15% to 20% of total area. BMQ did not convince me that it was able to increase its knowledge of cavernous concrete as part of this project.

[196] BMQ also had to be convinced that the objectives would be achieved since the cavernous concrete was installed underlayment of the draining concrete and the BCR, without the possibility of having access to it.

[197] I am not convinced that the scientific method was followed within the framework of this project. Indeed, a large-scale test was carried out directly without any prior test of the smallest size having been made. Observations were made using the instrumentation installed by the University of Waterloo, but only on the part of the parking lot covered by the draining concrete. For the rest, the observations seem above all to have been made visually. Similarly, the documentation produced by BMQ mainly concerns the approval of the work by the city and the stages of concrete installation. BMQ has agreed to withdraw its claim for deduction for all expenses relating to the hours devoted to the analysis of results, which suggests that the analysis of the performance of the drainage system was primarily visual.

[198] Thus, for these reasons, the activities carried out by BMQ cannot be qualified as SR&ED activities since, in particular, the criteria of technological or scientific uncertainty and technological or scientific progress have not been met.

[199] The appellant's argument that I should consider this project as part of the draining concrete project does not change my conclusion. BMQ has failed to demonstrate on a balance of probabilities how the combination of draining concrete and cavernous concrete created technological or scientific uncertainty and how technological or scientific progress would have been made in this regard. Indeed, the new knowledge described in the Vimy Henderson report relates almost exclusively to draining concrete.

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
chlorine penetration (coulombs)	3500	2500	Yes
compression resistance (x)	(not set)	(not set)	No
spalling (x)	(not set)	(not set)	No
freeze thaw stability (x)	(not set)	(not set)	No
air bubble distribution (x)	(not set)	(not set)	No

[233] In 2009-2010, the MTQ and the Canadian Standards Association (“CSA”) added a new requirement to the standards applicable to concrete , namely a permeability threshold for chlorine ions (maximum conductivity from 1000 coulombs to 56 days). This standard has been implemented since the chlorine ions passing through the concrete can cause the steel reinforcements of the concrete structures to rust, which we seek to avoid. Mr. Bertrand testified that in order to meet concrete standards, twenty-two tests must be performed, to which is now added the new test for permeability to chlorine ions.

[234] A grace period of a few months was granted to the companies to allow them time to do the tests necessary to demonstrate that their concrete mixes complied with the new standard.

[235] According to Mr. Bertrand, the new standard caught everyone in the industry off guard. BMQ did not measure the penetration rate of chlorine ions in its mixtures before the standards were changed, since this was not required. However, a standardized test existed in the industry to do this.

resistance to compression, spalling and the freeze / thaw cycle and to check the stability of the distribution of the network of air bubbles had to be carried out.

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Lab
Key Employees:	Jacques Bertrand (Civil - PEng. (1970) / President)
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[236] This project began on February 8, 2010 and ended on December 21, 2010. BMQ therefore undertook to verify whether its concrete mixes met the new standard. The objective of the project was to reformulate and optimize the concrete mixes according to the new standard. Mixtures with five different types of cement have been tested. According to Mr. Bertrand, the information available on each type of cement - for example, their technical data sheets - did not allow the permeability to chlorine ions to be determined in advance. For example, GU concrete (common concrete) had a chlorine ion permeability of 3500 coulombs, which exceeded the new standard.

[237] BMQ's assumptions included whether the different cements met the standard, whether BMQ blends were able to meet the standard, and, if the new standard was not met, what changes were to be made be made to the mixtures. According to Mr. Bertrand, the uncertainty was that BMQ did not know if the concrete mixes would comply with the new standard.

CRA ARGUED:
[243] According to the respondent [CRA], the activities carried out by BMQ in the context of this project are only an attempt to validate existing products with regard to applicable industry standards, and therefore, these activities cannot be qualified as activities of SR&ED. According to Mr. Mimoune, existing mixtures containing known ingredients were tested. The

techniques used by BMQ to adapt the mixes also fall under standard engineering techniques. The scientific method would also not have been respected since there are no links between the mixtures tested, that is to say that they do not fit into a logical sequence and that we have simply abandoned some when they did not meet the standard, instead of trying to understand the causes of failure.

The most significant underlying key variables are:

adding pozzolan (unresolved), modify mixing method (unresolved), effects of latex (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	Only quoted new government standards

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

Method	Experimentation Performed
Trials:	15 runs / samples

[238] BMQ carried out tests on fifteen mixtures. Five mixtures were subjected to more than one test. According to Mr. Bertrand, when a mixture did not meet expectations, it was either left out or reformulated. In addition, when a mixture was modified to reach the new standard, it then became necessary to check whether the other standards were still respected. Thus, tests to check the resistance to compression, spalling and the freeze / thaw cycle and to check the stability of the distribution of the network of air bubbles had to be carried out.

[239] After a first series of tests which led to the conclusion that no mixture complied with the new standard, BMQ modified the quantity of cement and modified the mixing sequence and the method of introducing the adjuvants; this second series of tests was successful for certain mixtures. Subsequently, BMQ decided to substitute pozzolanic mineral additions for a certain amount of cement in order to improve the compression results.

THE JUDGE NOTED:

[244] BMQ made an inventory of its products, checked which ones met the standards, changed the mixing sequence and how to introduce the adjuvants, balanced the content of cement and minerals like pozzolan in order to reformulate products and, after receiving the results of laboratory tests , selected the mixtures which complied with the standards. BMQ did not investigate the reasons why some of these mixtures did not meet the standards.

[247] BMQ first tried to characterize its various existing mixtures of concrete made with different types of cement. The timesheets produced in evidence describe validation activities of mixtures in relation to the various tests making it possible to determine whether the concretes met the standards. The timesheets do not show any time spent reformulating mixtures, but there are many hours spent discussing and analyzing results, as well as hours validating mixtures. I also note that the mixtures have been tested directly, without having been reformulated in any way. This therefore demonstrates that the activities consisted of normal data collection carried out within the framework of the BMQ business in order to validate the mixtures against the standards, so that these were not SR&ED activities.

[248] BMQ also carried out tests to verify the effect of pozzolan on cements as well as the effect of modifying the mixing method. According to Mr. Mimoune, pozzolan is a known material and its effects on porosity have also been well known and documented in the scientific literature for many years. In the response to the examination report, BMQ admitted that adding pozzolan and modifying the mixing method are techniques known in the industry, specifying however, the use of a mobile concrete mixer makes the results unpredictable.

Results:

chlorine penetration: 2800 coulombs (70% of goal) -- Average on 15 mixtures. 6 of 15 met the 2,500 goal.

[239] For six mixtures, these modifications made it possible to comply with the new standard and all the applicable standards.

[240] Mr. Bertrand also indicated that the addition of latex to a mixture containing a general purpose cement had increased the permeability to chlorine ions.

Conclusion:

RULING & RATIONALE: THE JUDGE CONCLUDED;

[248] BMQ however did not convince me that the use of a mobile concrete mixer brings a degree of scientific uncertainty that would justify that the activities be qualified as SR&ED activities.

[249] Although I accept that the standard for permeability to chlorine ions has been received with surprise by people in the industry, I do not see how the MTQ could have set up such a standard knowing that the companies subject to this standard could not meet it. This therefore also demonstrates an absence of scientific or technological uncertainty in this regard.

[250] Also, BMQ has not convinced me that it followed the scientific method for this project. Indeed, although tests have been made scientifically by an independent laboratory, a certain amount of trial and error is noticeable given the passage from one mixture to another without a specially detailed analysis of the reasons why a mixture respects the standards or does not meet them.

[251] Finally, with regard to the existence of a detailed report, the tests carried out by BMQ can be partially reconstructed using the documentation produced at the hearing and the testimony of representatives of BMQ.

[252] Thus, for these reasons, the activities carried out by BMQ in the context of this project cannot be qualified as SR&ED activities since they consist of normal product characterization tests that have not created scientific uncertainty.

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Cause of aggregate segregation (yes =1 or no = 0)	0	1	No

[333] According to Mr. Dubé, a contractor working for Hydro Québec used the mixture developed within the framework of project B 11 04 to make repairs to the Manouane C Dam. However, the inputs contained in the mixture segregated.
[334] According to BMQ, project B 12 02 is a continuation of project B 11 04. BMQ retested its mixture, which showed that the test results remained satisfactory and did not match the problems encountered by its client.
[335] Mr. Dubé tried to increase the dose of the colloidal agent in the mixture, thereby increasing the viscosity of the mixture so that the various inputs remain in suspension and do not separate. This addition, however, made the mixture too fluid. The mixture was therefore reformulated and other tests carried out, with varying degrees of success.

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:
Work locations: field
Key Employees: Jacques Bertrand (Civil - PEng. (1970) / President)
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

APPELLANT ARGUED:

[339] According to the appellant, the activities undertaken by BMQ in the context of this project constitute SR&ED activities, since these aim to determine the factors that may affect a mixture on the job site, which met standards when it was tested in laboratory. New knowledge on the impact of water on concrete was acquired during this project. The activities therefore constitute SR&ED activities since they can be qualified as experimental development work undertaken in the interest of technological progress.

CRA ARGUED:
[340] According to the respondent, the activities cannot be classified as SR&ED. According to Mr. Mimoune, the mixture used was already known to BMQ, although adjustments regarding the dosage of the inputs were made. The steps taken by BMQ were aimed at solving a technical problem, which was done by the trial-and-error method since BMQ used public data and the experience of its staff and collaborators to solve the problem. problem. In addition, the problems encountered in the development of the mixture are normal difficulties whose solutions are part of current practice. In this case, BMQ designed existing technologies, which was feasible with a certain effort and reasonable skills.

The most significant underlying key variables are:

WATER CONTENT & CONTAMINANTS (unresolved), effects of colloidal agents (unresolved), effects of plasticizers (unresolved), setting agents (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2020)

Methods of experimentation:

Method	**Experimentation Performed**
Analysis / simulation:	4 alternatives
Trials:	4 runs / samples

[335] Mr. Dubé tried to increase the dose of the colloidal agent in the mixture, thereby increasing the viscosity of the mixture so that the various inputs remain in suspension and do not separate. This addition, however, made the mixture too fluid. The mixture was therefore reformulated and other tests carried out, with varying degrees of success.
[336] After analyzing various factors that could cause a mixture to segregate, such as the weather or the presence of vibrations, Mr. Dubé concluded that the only factor of variation was the local water used to prepare the mixture. In principle, concrete is made with potable water; the literature indicates that water should not have an impact on a mixture, unless organic matter is present there. However, after having repeated the tests with a sample of the site water, Mr. Dubé discovered that the water used on the site in question was problematic, even if this water was potable. Mr. Dubé is however unable to specify the element present in the water that could have had this effect.
[337] According to Mr. Dubé's testimony, water was therefore delivered to the site to allow the work to be completed. From now on, when a project is done in a remote region, BMQ requests that the water to be used in the mixture be sent to it beforehand so that it can carry out tests to ensure that the mixture will not be affected.

Results:

[336] After analyzing various factors that could cause a mixture to segregate, such as the weather or the presence of vibrations, Mr. Dubé concluded that the only factor of variation was the local water used to prepare the mixture. In principle, concrete is made with potable water; the literature indicates that water should not have an impact on a mixture, unless organic matter is present there. However, after having repeated the tests with a sample of the site water, Mr. Dubé discovered that the water used on the site in question was problematic, even if this water was potable. Mr. Dubé is however unable to specify the element present in the water that could have had this effect.

Conclusion:

RULING & RATIONALE: THE JUDGE CONCLUDED;

[341] The evidence did not convince me, on a balance of probabilities, that there was a technological uncertainty that could not be resolved by current technical or practical studies and that the process led to technological progress.

[342] BMQ used current technological knowledge to improve the product developed within the framework of the B 11 04 project, which does not necessarily demonstrate technological uncertainty. There would have been technological uncertainty if BMQ had convinced me that the probability of achieving the objectives or the way to achieve them could not be known or determined in advance based on the experience or technological knowledge usually available. BMQ was faced with uncertainty as to the causes of the unsatisfactory results of a mixture whose performance had been previously tested. In my opinion, the addition of a colloidal agent to decrease the segregation of a mixture and the analysis of weather and vibrations are common techniques in the industry.

[343] Also, the documentary evidence does not support the explanation of the project given by Mr. Dubé at the hearing. In his testimony, Mr. Dubé indicated that progress in this project consists in the fact that BMQ has acquired the knowledge that water, even drinking water, can affect the results of a mixture. However, the only mention of water on Form T661 is that indicating that the water had been analyzed since the only variable under construction in relation to laboratory tests is the water-binder ratio. Form T661 indicates that technological progress lies in the acquisition of knowledge related to the effect of certain adjuvants, namely the colloidal agent VMA 362, the plasticizer Glenium 7500 and the setting accelerator Pozzutec 20+, in the formulation of the mixture and in the acquisition of knowledge on the impact of these elements on the fluidity. There is no mention of water as an element that could have an impact on the mixture. Similarly, in the letter from BMQ dated November 12, 2013 addressed to the CRA (exhibit I 3, tab 10), BMQ indicated that the technological advancement of this project consists in understanding the causes of the instability mixing and developing a solution with regard to formulation or mixing; technological uncertainty was due to the question of what would be the synergy of the adjuvants used (colloidal agent, plasticizer and setting accelerator) in reaction with the cement. According to this letter, tests have shown that the effect produced by an adjuvant could affect the effect that one sought to obtain by means of another adjuvant present in the formulation. Nowhere in this letter is there any mention of the effect of water on the mixture.

[344] I conclude that Mr. Dubé's testimony is not consistent with the content of the T661 form and what BMQ claims in the letter of November 12, 2013. Similarly, the timesheets produced in evidence indicate that the water used in this project has been tested and found to comply. There is no mention of the tests carried out with different water that Mr. Dubé talked about.

[345] Several laboratory tests were carried out, but, overall, BMQ proceeded by the trial-and-error method to determine the cause of the problems with its mixture and not by applying the scientific method, even if several hypotheses were put forward by BMQ, although they were not explicitly stated at the hearing.

[346] Finally, as in the case of the other projects, the BMQ tests can be partially reconstructed using its documentation, but a report compiling the tests and making it possible to follow BMQ's thinking throughout the project. has not been prepared. In addition, as mentioned above, Mr. Dubé's testimony is not in accordance with Form T661 and the letter from BMQ dated November 12, 2013.

[347] Thus, for these reasons, the activities carried out by BMQ in the context of this project cannot be qualified as SR&ED activities since, in particular, the criteria of technological uncertainty and technological progress were not met.

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
On pump primary composite outcome CABG (%)	12.5	13	Yes
Off pump primary composite outcome CABG (%)	12	13	Yes
On pump repeat coronary revascularization (%)	1	0.5	Yes
Off pump repeat coronary revascularization (%)	1	0.5	Yes

This project example is based on the Tax Court of Canada judgment for Andre Lamy Medicine Professional Corporation v. The Queen (2020 TCC 61).

STATEMENT OF AGREED FACTS

1, The Appellant was a corporation located in Ontario.

2. The Appellant was incorporated on June 23, 2008.

3. Dr. Lamy was the Director, President and Secretary of the Appellant.

4. The Appellant was the medical professional corporation of Dr. Lamy and carried on the business of performing cardiac surgery, providing associated medical care to patients and researching improvements in cardiac surgical methodology and clinical [outcomes].

5. Dr. Lamy was also employed as a Professor of the Faculty of Health Sciences at McMaster University where his teaching duties included lecturing on research methodology and the inclusion of students in cardiac surgery.

6. During the 2013 and 2014 taxation years, Dr. Lamy was involved in experimental projects relating to advancements in cardiac surgical techniques and treatments.

There were two studies known as

the Vision study, that included projects referred to throughout as "Vision" and "Coronary", and

the Compass study, that included projects referred to throughout as "Compass" and "Accelerate" (the “Projects").

[NOTE: CRA CONCEDED ELIGIBILITY OF VISION AND ACCELERATE PROJECTS]

8. Careful SRED time tracking dockets were kept as required, and detailed representations and information packages regarding the Projects were prepared.

9. SRED tax credits for its 2013 and 2014 taxation years in the amounts of $93,828.00 and $107,642.00, respectivelY.

10. The Research Agreements leading to the Projects were signed by Dr. Lamy without noting his capacity as director of the Appellant.

ll. Dr. Lamy was not required by his employment agreement with McMaster University to undertake research within the meaning of subsection 248(1) of the Act.

21. During the 2013 and 2014 taxation years, Dr. Lamy spent approximately 52 to 57 per cent of his time working on these four projects. He testified that he conducted all of his research as an employee of the Appellant.

The largest project (Coronary) involved developing and comparing techniques for Coronary Artery Bypass Grafting (CABG) with or without a pump. WE WILL USE THE FACTS OF THIS PROJECT FOR THIS EXAMPLE.

PROJECT PROTOCOLS:
In a recent survey of Canadian heart surgeons, Desai et al reported that a majority of surgeons believe that off-pump CABG improves clinical outcomes but concerns regarding incomplete revascularization, technical demands and the lack of proven clinical benefits have limited the routine performance of off-pump CABG in Canada.

Many investigators have indicated an urgent need for a large scale RCT of off-pump CABG vs. on-pump CABG with a long-term follow-up. A recent Scientific Statement from the American Heart Association and recommendations from the National Heart, Lung, and Blood Institute Working Group have reiterated the need for a,

“large, multicenter, randomized clinical trial to compare the procedures and the effect of CABG on neurocognition, renal failure, infection, and blood requirements, as well as to explore other questions”.

1.1 Study Objectives

Primary: In patients undergoing CABG surgery, does off-pump CABG surgery compared to on-pump CABG surgery reduce major clinical vascular events in the short term (30 days) and are the benefits maintained at long term (5 years)? The primary outcome at 30 days is total mortality, stroke, MI and new renal failure requiring dialysis and at 5 years, the same outcomes plus repeat revascularization.

We are therefore proposing a large multicentre international randomized trial with long term follow-up to provide definite answers to a clinically important question.We have two co-primary outcomes:

The first co-primary outcome is the occurrence of the composite of total mortality, stroke, nonfatal MI, or new renal failure at 30 days post randomization (randomization = day 1).

The second co-primary outcome is the occurrence of the composite of total mortality, stroke, nonfatal MI, new renal failure, or repeat coronary revascularization (i.e. coronary artery bypass surgery or percutaneous coronary intervention) over 5 years after randomization.

Secondary: In patients undergoing CABG surgery, does off-pump CABG surgery compared to on-pump CABG surgery reduce costs in the short term (30 days) and at long term (5 years) (cost-effectiveness analysis)?

Field of Science/Technology:

Cardiac and cardiovascular systems (3.02.04)

Project Details:

Intended Results:	Develop new processes
Work locations:	Research Facility
Key Employees:	Andre Lamy (Cariothoracic surgery - MD,PhD (2000) / Surgeon)
Evidence types:	Design of experiments; Records of trial runs; Progress reports, minutes of project meetings; Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Project records, laboratory notebooks; Project planning documents

Scientific or Technological Advancement:

Uncertainty #1: Coronary project - on vs. off pump factors

All of the projects themselves were deemed eligible from a technology perspective.

The CRA's challenges instead related to the issues of whether Dr. Lamy was;

1) performing SR&ED in role as Principal Investigator on projects sponsored by other companies &

2) "directly" vs. "indirectly" engaged on each project.

The following is a brief summary of the uncertainties related to the largest project (Coronary) reproduced from the actual protocols as published:

For the second co-primary outcome at 5 years, it is more difficult to predict if the treatment effect will follow a proportional hazard model or not (an earlier benefit from off-pump CABG could be lost at long term with an excess in re-revascularization per example).

If the proportional hazards assumption holds for outcomes at 5 years, we will proceed as described with the first co-primary outcome above. If the proportional hazards assumption does not hold for outcomes at 5 years, we will fit a Cox model with an extra time-dependent covariate, which is the interaction term between the treatment and the survival time. This time-varying treatment effect will also be examined by the Aalen's additive hazards model.

This type of model will allow the risk to be estimated within discrete time periods to further describe the difference due to treatment group. Participants who prematurely discontinue follow-up before a major cardiovascular event will be censored as to their last follow-up data.

In secondary analyses we will compare the incidence of each of the individual major cardiovascular events (total mortality, stroke, nonfatal MI, new renal dialysis) and revascularization procedures (i.e. coronary artery bypass surgery and percutaneous coronary intervention) using the same strategy.

We will be testing hypotheses for two co-primary outcomes which are correlated with each other. An adjustment to the a level for each of the two tests of the co-primary outcomes is needed. The a level for the test of the first co-primary outcome (0.048) was determined through 10,000,000 simulations while fixing the a level for the test of the second co-primary outcome at 0.01.

APPENDIX A
Protocol Subgroups
-Diabetes
-Cerebrovascular disease
-Peripheral arterial disease
-Left ventricular function: Grade 1 to 4
-Number of vessels diseased: left main, single, double, or triple
-Gender:M/F
-Age: <70 years old, =70 years old
-Euroscore: into 3 groups i.e. 0 to 2, 3 to 5 & >5

The most significant underlying key variables are:

Effect of diabetes, Cerebrovascular disease, Left ventricular function: Grade 1 to 4, Number of vessels diseased (unresolved), Euroscore

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Competitive products or processes	56 products	https://www.nejm.org/doi/suppl/10.1056/NEJMoa1301228/suppl_file/nejmoa1301228_protocol.pdf These protocols cite 56 other studies relating to variables in the design of the study.
Similar prior in-house technologies	5 products / processes	Dr. Lamy has published peer reviewed papers regarding the states of Coronary project technology. Original invesitagations began 2007.
Queries to experts	12 responses	12 other specialists listed in protocol development

Activity #1-1: Coronary project (Fiscal Year 2021)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	2 alternatives
Trials:	4752 runs / samples

Improve Coronary Artery Bypass Grafting techniques:

[17] With respect to the Coronary Project, he testified that it related to bypass surgery. He referred to two techniques that are used when conducting bypass surgery.

One is called a cardiopulmonary bypass, or the pump. This involves stopping the heart while the bypass is performed.

The second technique is called off-pump. A pump is not used and the bypass is performed while the heart is beating.

Dr. Lamy noted that there was much discussion in the medical community with respect to which technique is better. As a result, he decided that he would try to answer that question by starting the Coronary Project.

He has been working on the project for ten years and it is not yet completed. He worked on this project during the 2013 and 2014 taxation years.

ADDITIONAL DETAILS FROM INTERNET: PUBLISHED REPORT 2013

Background: Previously, we reported that there was no significant difference at 30 days in the rate of a primary composite outcome of death, myocardial infarction, stroke, or new renal failure requiring dialysis between patients who underwent coronary-artery bypass grafting (CABG) performed with a beating-heart technique (off-pump) and those who underwent CABG performed with cardiopulmonary bypass (on-pump).
Log#:1,End Date:2021-04-30,Analysis/simulations:2 alternatives, Trials:4752 runs / samples, Physical prototypes:0 , Line of code:0 , Other methods:0 ,

Results:

- On pump primary composite outcome CABG: 13.3 % (160% of goal)
- Off pump primary composite outcome CABG: 12.1 % (10% of goal)
- On pump repeat coronary revascularization: 0.8 % (40% of goal)
- Off pump repeat coronary revascularization: 1.4 % (no improvement)

ADDITIONAL DETAILS FROM INTERNET:

Dr. Lamy's most significant contribution in cardiac surgery is the CORONARY trial for which he received a large grant from the Canadian Institute of Health Research in 2007.

CORONARY is a large multi centred randomized trial of off-pump CABG surgery versus on-pump CABG surgery. CORONARY has recruited and randomized 4,752 patients from 79 centres in 19 countries.

The results were presented at the Late Breaking Clinical Trials at the American College of Cardiology meeting in 2012 and 2013 and were published in the New England Journal of Medicine in 2012 and 2013.

The trial recently finished with a follow-up of five years. These final results were published in the New England Journal of Medicine October 2016.

ADDITIONAL DETAILS FROM INTERNET: PUBLISHED REPORT 2013

Results: At 1 year, there was no significant difference in the rate of the primary composite outcome between off-pump and on-pump CABG (12.1% and 13.3%, respectively; hazard ratio with off-pump CABG, 0.91; 95% confidence interval [CI], 0.77 to 1.07; P=0.24).

The rate of the primary outcome was also similar in the two groups in the period between 31 days and 1 year (hazard ratio, 0.79; 95% CI, 0.55 to 1.13; P=0.19).

The rate of repeat coronary revascularization at 1 year was 1.4% in the off-pump group and 0.8% in the on-pump group (hazard ratio, 1.66; 95% CI, 0.95 to 2.89; P=0.07).

There were no significant differences between the two groups at 1 year in measures of quality of life or neurocognitive function.

Conclusion:

[47] [the CRA conceded eligibility of the] Vision and Accelerate Projects.

However, the Respondent (CRA) argues that the documents provided with respect to the Coronary Project and the Compass Project are not consistent with a factual finding that the Appellant performed the SR&ED.

I (the judge) do not agree.

CONCLUSIONS - DETAILS FROM INTERNET: PUBLISHED REPORTS 2013 & 2016

Conclusions: At 1 year after CABG, there was no significant difference between off-pump and onpump CABG with respect to the primary composite outcome, the rate of repeat coronary revascularization, quality of life, or neurocognitive function.

In our trial, the rate of the composite outcome of death, stroke, myocardial infarction, renal failure, or repeat revascularization at 5 years of follow-up was similar among patients who underwent off-pump CABG and those who underwent on-pump CABG.

AUTHOR'S NOTE:

BECAUSE THE PROJECT WAS SPONSORED BY ANOTHER PARTY (CANADIAN INSTITUTE FOR HEALTH RESEARCH) THE CRA SCRUTINIZED WHETHER THE SPONSOR OR DR. LAMY WAS CONDUCTING THE SR&ED. IN THIS CASE HE APPEARED TO HAVE BEEN THE PRIMARY DESIGNER OF THE PROTOCOLS.

Significant variables addressed: Cerebrovascular disease, Effect of diabetes, Euroscore, Left ventricular function: Grade 1 to 4

Documentation:

- Uploaded to RDBASE.NET: Dr. Andre Lamy Published reports on Coronary Project.pdf (153KB), Andre Lamy MPC SRED Tax ruling -WIN Directly Engaged.pdf (202KB), Effects of off-pump and on-pump coronary-artery bypass grafting at 1 year - PubMed.pdf (85.2KB)
- Offline Documents: docs

Activity #1-2: 2022 development (Fiscal Year 2022)

Methods of experimentation:

Results:

Conclusion:

Uncertainty #2: Compass project

The most significant underlying key variables are:

factors affecting Rivaroxaban (unresolved)

Technology or Knowledge Base Level:

Activity #2-1: Compass - effects Rivaroxaban on cardiac patients (Fiscal Year 2021)

Methods of experimentation:

Method	**Experimentation Performed**
Analysis / simulation:	1 alternatives
Trials:	27000 runs / samples
Physical prototypes:	2 samples
Other methods:	10

[19] The Compass Project is a large trial project. Dr. Lamy was involved in a small portion of the project; that portion involved testing the medication Rivaroxaban with certain patients.

Dr. Lamy noted this his involvement related to the small portion of the test population who had undergone cardiac surgery. He worked on the project during the 2013 and 2014 taxation years and continues to work on the project today.

[28]Compass Project (the “Compass Letter of Understanding”). The letter is signed by the Hamilton Health Sciences Corporation (identified in the letter as “HHSC”) and Dr. Lamy.

The purpose of the Compass Letter of Understanding appears to be to discuss HHSC's and Dr. Lamy's role in the Compass Project, which was sponsored and funded by Bayer Healthcare AG. Dr. Lamy noted that worldwide there were approximately 27,000 patients who participated in the Compass Project.

[29] The letter states that Bayer Healthcare AG has authorized Bayer Inc., a corporation with an address in Toronto, to act on its behalf regarding all matters related to the conduct of the study in Canada.

[30] The Compass Letter of Understanding indicates that Bayer Inc. has entered into a clinical trial service agreement with HHSC, pursuant to which HHSC is to manage the Compass Project, including supervising the investigators.

The letter refers to Dr. Lamy as being the "Principal Investigator." In his testimony, Dr. Lamy clarified that there were approximately 600 investigators involved in the Compass Project and that he was the local Principal Investigator, meaning he was the Principal Investigator for the patients in the Hamilton hospital.

[31] It appears that the role of the Principal Investigator was to pre-screen patients and then recruit qualifying patients for the project.

Appendix A states that the Principal Investigator shall carry out the "Study Activity". The Compass Letter of Understanding does not explain this term. It appears to relate to activities HHSC was required to perform under its agreement with Bayer Inc. I was not provided with a copy of that agreement.

[AUTHOR'S NOTE: THIS TYPE OF INFORMATION WILL BE RELEVANT IN HELPING THE JUDGE ASSESS DR. LAMY'S INVOLVEMENT IN THE PROTOCOL DESIGN. GIVEN THE SUCCESSFUL RESULT WE WILL ASSUME IT IS SIMILAR TO THE CORONARY PROJECT.]

[32] On the second page of the Compass Letter of Understanding it is stated that HHSC, on behalf of Bayer Inc., shall pay Dr. Lamy for the services provided in accordance with Appendix B to the letter of understanding.

Dr. Lamy testified that HHSC did not pay any amounts to either him or the Appellant in respect of the Compass Project. The only monies he received were the amounts paid to him by the Appellant as salary.

[AUTHOR'S NOTE: PAYMENTS FOR THE RESEARCH FROM ANOTHER CANADIAN COMPANY MAY BE "CONTRACT PAYMENTS" TO REDUCE ELIGIBLE SR&ED.]

Results:

THE CASE DID NOT PROVIDE SPECIFIC DETAILS ON THIS PROJECT. SINCE IT WAS SPONSORED BY A PRIVATE COMPANY (BAYER) THE RESULTS ARE NOT PUBLIC.

Conclusion:

[47] [the CRA conceded eligibility of the] Vision and Accelerate Projects.

However, the Respondent (CRA) argues that the documents provided with respect to the Coronary Project and the Compass Project are not consistent with a factual finding that the Appellant performed the SR&ED.

I (the judge) do not agree.

[AUTHOR'S NOTE: BECAUSE THE PROJECT WAS SPONSORED BY ANOTHER PARTY (I.E. BAYER PHARMACEUTICAL COMPANY / RIVAROBAXIN PRODUCER) THE CRA SCRUTINIZED WHETHER THE SPONSOR OR DR. LAMY WAS CONDUCTING THE SR&ED.

IN SUCH CASES IT IS IMPORTANT TO OUTLINE HOW;

- THE PERFORMER (DR. LAMY) PROVIDED INPUT INTO THE PROTOCOL DESIGN ITSELF VS.
- JUST PROVIDING DATA FOR THE SPONSOR TO INTERPRET & ANALYZE.]

Uncertainty #3: Whether "directly engaged"

The most significant underlying key variables are:

Yes, No (unresolved)

Technology or Knowledge Base Level:

COMMERCIAL CO

Activity #3-1: Who performed the SR&ED? (Fiscal Year 2021)

Methods of experimentation:

The court examined contracts related to 2 of the projects.

[34] Dr. Lamy testified that he signed the Coronary Agreement and the Compass Letter of Understanding in his capacity as an employee of the Appellant, since he provided the services specified in the agreement and the Compass Letter of Understanding as an employee of the Appellant.

[36] As I noted previously, the issue before the Court is whether the Appellant carried out the SR&ED or whether Dr. Lamy conducted such research in his personal capacity. This is a question of fact.

[37] The Respondent (CRA) presented no witnesses in support of her factual conclusion that Dr. Lamy carried out the SR&ED in his personal capacity.

The only subparagraphs that support the Minister's argument that Dr. Lamy, and not the Appellant, conducted the SR&ED are subparagraphs 10 e) and f) of the Reply. These subparagraphs contain the following factual conclusions:

e) the SR&ED in question was undertaken by Dr. Lamy in his personal capacity; and

f) the SR&ED in question was not undertaken directly by the Appellant nor on behalf of the Appellant by Dr. Lamy.

[38] The Reply does not contain any assumptions of fact made by the Minister that support these two factual conclusions.

As a result, I will base my decision on the relevant evidence before me, namely, the testimony of Dr. Lamy, the admissions made by the parties, the facts contained in the SAF and three of the documents included in Exhibit AR-1.

[52] That it was Dr. Lamy who signed the Coronary Agreement and the Compass Letter of Understanding does not change the fact that he performed the research activities as an employee of the Appellant.

Dr. Lamy acknowledged that he signed the Coronary Agreement and the Compass Letter of Understanding as Andre Lamy. He noted that this is how he signs all documents.

However, he stated that he signed the documents in his capacity as an employee of the Appellant, since he provided the services as an employee of the Appellant.

[53] Dr. Lamy's testimony is supported by the billings made for his medical services.

He bills the Government of Ontario for such services in his own name.

The Respondent does not challenge the Appellant's position that any monies received in respect of such services are received by Dr. Lamy for and on behalf of the person providing the service, i.e., his employer, the Appellant.

The result is the same with respect to the research activities: Dr. Lamy signed his own name on the contracts, but he provided the services as an employee of the Appellant. [CONSISTENCY]

Results:

[39] As I noted previously, Dr. Lamy testified that he performed all of his research activities as an employee of the Appellant. His testimony is consistent with the admissions made by the Respondent and the subjective evidence before me.

[43] Since Dr. Lamy is the only employee of the Appellant, clearly he is the only one conducting the business of the Appellant, namely performing surgery, providing care to patients and conducting medical research. In other words, if the Appellant carried out the research in question in these appeals, then Dr. Lamy had to perform the research work.

[54] The evidence before me is that from 2008 until the present time any activities of Dr. Lamy relating to the business of the Appellant, including researching improvements in cardiac surgery, were activities of his employer, the Appellant.

[44] The Employment Agreement specifically provides that Dr. Lamy shall not devote any of his time to any business other than the business of the Appellant. He testified that he complied with this provision and I received no evidence to contradict his testimony.

Conclusion:

[46] On the basis of these facts and the other evidence before me, I conclude that the Appellant performed the SR&ED.

Dr. Lamy physically performed his research as an employee of the Appellant.

[AUTHOR'S NOTE: THIS PROVIDES A DEGREE OF CLARITY TO ALL CLAIMS BY MEDICAL PROFESSIONAL

CORPORATIONS. SPECIFICALLY IT RECOGNIZES THAT THE DOCTOR HIM OR HERSELF CAN REPRESENT THE CORPORATION WHEN SIGNING DOCUMENTS.]

Significant variables addressed: Yes

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
maximum draft (m)	7	8.15	No
UKC “under-keel clearance” (cm)	50	30	No

This project example is based on the Tax Court of Canada judgment for Indusol Industrial Control Ltd. v. The Queen (2020 TCC 103).

INTRODUCTION

[1] Indusol Industrial Control Ltd. (“Indusol” or the “Appellant”) filed an appeal for its 2012 taxation year.

[2] In so reassessing, the Minister of National Revenue (the “Minister”) ... rejected Indusol’s claim that expenses totalling $111,883 were SR&ED as well as the investment tax credit (“ITC”) of $49,224 claimed in connection with those expenses.

[3] At the hearing, Mr. Robbert Jan van Eijle, the president of Indusol, as well as its sole shareholder and director, represented Indusol and testified on its behalf. Ms. Sandrine Nothomb, a Canada Revenue Agency (“CRA”) financial examiner, as well as Ms. Nadine Bisson, a CRA research and technology advisor, who both reviewed the DIS Project, also testified at the hearing.

[11] The DIS Project objective was described as being to determine whether it is possible for a vessel to transit from Montreal to Lake Erie (via Lake Ontario and the Welland Canal) consistently at a draft of 8.15 m with a minimum UKC of 30 cm.

[114] The overall [technological] objective of the DIS implementation specifications was to develop a standard that specified how the UKC of a vessel could be calculated by considering water level, bottom depth and ship dynamics. Mr. van Eijle confirmed that the purpose of this document was to ensure that any DIS system used on the Seaway would meet certain minimum requirements or would calculate the UKC in a specific manner.

Field of Science/Technology:

Computer sciences (1.02.01)

Project Details:

Intended Results:	Develop new processes
Work locations:	Research Facility
Key Employees:	Robbert Jan van Eijle (shipping management - no technical background noted in case (2000) / President)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Design, system architecture and source code; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: 5 Questions - Technological Uncertainty vs. Systematic Investigation

The judge reviewed the eligibility using the 5 questions cited in the Northwest Hydraulics Case.

1- Was there a technological risk or uncertainty which could not be removed by routine engineering or standard procedures?
2- Did Indusol formulate hypotheses specifically aimed at reducing or eliminating the technological uncertainty?
3- Did the procedure adopted accord with the total discipline of the scientific method, including the formulation, testing and modification of hypotheses?
4- Did the process result in a technological advancement?
5- Was a detailed record of the hypotheses tested, and results kept as the work progressed?

[47] The Appellant identified several uncertainties and challenges which arose either in the 2012 taxation year or throughout

the period from 2010 to 2012. According to the Respondent, these uncertainties and challenges were not technological uncertainties within the meaning of the SR&ED criteria, as many of the stated uncertainties had to do simply with decisions that the DIS Workgroup needed to make with respect to the DIS standards. Also, in some instances, Indusol did no more than identify the problems, which is not an SR&ED activity.

[48] For the reasons stated below, I find that, on a balance of probabilities, only some of the uncertainties raised with respect to the squat issues constitute technological uncertainties within the meaning of the SR&ED criteria. Other uncertainties and challenges identified by the Appellant do not constitute technological risks or uncertainties within the meaning of the SR&ED criteria.

The most significant underlying key variables are:

How to measure velocity of current in real time (unresolved), Squat formula for different sections of channel, Squat for vessels at differing speeds

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	test
Similar prior in-house technologies	2 products / processes	The formulas to calculate the squat in various situations were originally developed by the Université Laval in 2002. From 2008 to 2010 Indusol developed the DIS system.

Activity #1-1: Technological Uncertainty (TU) Existed (Fiscal Year 2021)

Methods of experimentation:

Method	Experimentation Performed
Trials:	50 runs / samples

[13] ... in November 2010, a workgroup which included industry players (system manufacturers and shipping enterprises) and representatives of the Seaway Authorities, as well as Mr. van Eijle and Mr. O'Brien of Idon Technologies (the "DIS Workgroup") was formed and met for the first time.

The objective of the DIS Workgroup was to oversee the process for the drafting of the DIS implementation specifications, including the various conformance test procedures. Since the first draft prepared by the Seaway Authorities was clearly unsatisfactory, Mr. van Eijle, through Indusol, volunteered to act as the technical reference for the drafting of these implementation specifications, and Mr. O'Brien was hired to actually write them.

[14] Throughout 2011, various drafts of the DIS implementation specifications were prepared and posted on the Seaway Authorities' websites for public comment, and various meetings of the DIS Workgroup were held. The Seaway Authorities accepted that some testing of the DIS be done by Indusol in the Seaway. After each round of publication, the DIS Workgroup met to resolve any concerns raised, and additional research was done to that end.

[47] The Appellant identified several uncertainties and challenges which arose either in the 2012 taxation year or throughout the period from 2010 to 2012.

According to the Respondent (CRA), these uncertainties and challenges were not technological uncertainties within the meaning of the SR&ED criteria, as many of the stated uncertainties had to do simply with decisions that the DIS Workgroup needed to make with respect to the DIS standards.

Also, in some instances, Indusol did no more than identify the problems, which is not an SR&ED activity.

a) Gathering hydrographical data
b) Hydraulics issues
c) Under Keel Clearance issues
d) Squat issues
e) User interface and display requirement
f) Water level information
g) Communication

(d) Squat issues
[58] According to Mr. van Eijle, issues relating to squat (which is the extra sinkage of a vessel created by the speed of the vessel through the water) were the biggest challenges faced by Indusol in the DIS Project.

[59] The evidence showed that different squat formulas have to be used in various situations, depending on the type of ship, the type of channel, and speed ranges.

Indusol tested the accuracy of squat formulas from different sources and decided to implement the formulas developed by the Université Laval in 2002. Furthermore, the evidence showed that Indusol had to determine how to implement and apply the squat formulas within the DIS.

[60] Even though the squat formulas used by Indusol were already available, I find that, on a balance of probabilities, there were still some technological uncertainties involved in the process for the implementation of the squat formulas within the DIS. These uncertainties with respect to the additional squat that occurs when two vessels meet in a channel could not be resolved by routine engineering or standard practices.

[61] Technological uncertainty within the meaning of the SR&ED criteria may occur in either of two ways: ". . . it may be uncertain whether the goals can be achieved at all; or the taxpayer may be fairly confident that the goals can be achieved, but may be uncertain which of several alternatives (i.e., paths, routes, approaches, equipment configurations, system architectures, circuit techniques, etc.) will either work at all, or be feasible to meet the desired specifications or cost targets, or both of these" (the Circular, at para. 2.10.2).

[62] The Appellant identified three uncertainties with respect to implementing the squat formulas in the DIS:

(1) the speed of a vessel could not be easily measured because there was no solution for measuring the velocity of the current in real time;
(2) the squat formula needed to be altered for different sections of the channel; and
(3) the additional squat that occurs when two vessels approach each other at different speeds has to be accounted for.

[63] According to Mr. van Eijle, the first major uncertainty in the implementation process was to ascertain how to measure the speed of a vessel through the water while taking into consideration the velocity of the current. Furthermore, Mr. van Eijle testified that there was no solution for measuring the velocity of the current in real time.

Indusol proposed using a table in order to determine the velocity of the current. To calculate the actual speed through the water of a vessel navigating downstream, the velocity of the current would be added to the GPS speed of the vessel. To calculate the actual speed of a vessel navigating upstream, the velocity of the current would be deducted from the GPS speed of the vessel.

Indusol was requested to test the proposal on board vessels, and the proposal was ultimately accepted.

[65] According to Mr. van Eijle, the second major uncertainty was how to change the squat formulas according to the channel type during a ship's transit. Indusol proposed dividing the Seaway into multiple sections and assigning a channel type to each section. When a vessel travelled in a certain section, the system would apply the appropriate squat formula for the section depending on the assigned channel type. Indusol was requested to test the proposal and this proposal was also ultimately accepted.

[67] The third major uncertainty was how to take into account the increased squat when two vessels meet in a channel. Since the additional squat was uncertain, Indusol performed tests to measure the additional squat when two ships were traveling at different speeds. This additional squat was then added to the squat calculation.

Results:

[64] Regarding the first uncertainty, I find that, on a balance of probabilities, there was no technological uncertainty within the meaning of the SR&ED criteria, because I am not satisfied that the uncertainty could not be resolved using routine engineering or standard procedures.

Mr. van Eijle testified that he proposed to use a table in order to determine the velocity of the current. No evidence was adduced at the hearing as to the difficulty involved in this method, or as to whether the table was readily available to competent professionals in the industry. Therefore, I find that the Appellant has not shown that this was a technological uncertainty which could not be removed by the application of routine engineering or standard procedures.

[66] As regards the second uncertainty, I find that, on a balance of probabilities, there was no technological uncertainty within the meaning of the SR&ED criteria because I am not satisfied that the uncertainty could not be resolved using routine

engineering or standard procedures.

The evidence showed that the various squat formulas developed by the Université Laval in 2002 took into account the different channel types. I find that routine engineering or standard procedure could have been used to resolve that uncertainty.

[68] Concerning the third uncertainty, the evidence showed that the Université Laval's research did not include a method to calculate the additional squat when two vessels approach each other at different speeds.

The Appellant was uncertain as to whether the proposed solutions would be effective in achieving the goals or desired specifications. Therefore, I find that, on a balance of probabilities, the evidence showed that there was technological uncertainty within the meaning of the SR&ED criteria.

[91] According to the Timeline, during a DIS Workgroup meeting held on June 13, 2011, the uncertainties associated with the squat issues were identified. Indusol proposed potential solutions to address these uncertainties. At the hearing, Mr. van Eijle further explained the various proposals.

[92] According to the Respondent, there is no evidence that the Appellant formulated any hypothesis designed to reduce or eliminate the uncertainties or that it conducted a methodical and systematic testing of the hypothesis. The evidence showed that Mr. van Eijle would identify a problem and try to resolve it, but the process involved is unclear.

Conclusion:

[69] For these reasons, I find that, on a balance of probabilities, there was some technological uncertainty within the meaning of the SR&ED criteria as regards the implementation of the squat formulas within the DIS.

This uncertainty was with respect to the additional squat when two vessels meet in a channel. I also find that Indusol carried out the above-described activities during the 2012 taxation year.

[93] On the evidence adduced at trial, I find that, on a balance of probabilities, hypotheses were formulated that were designed to reduce or eliminate the technological uncertainties involved with respect to the squat issues.

However, for the reasons explained below in the section dealing with the third criterion, I am not convinced that Indusol conducted a methodical and systematic testing of the hypotheses.

Accordingly, I find that the second criterion is not met, as it requires the methodical and systematic testing of hypotheses.

Significant variables addressed: Squat for vessels at differing speeds, Squat formula for different sections of channel

Documentation:

- Uploaded to RDBASE.NET: Indusol SRED tax ruling - SI & software - LOSS with Costs.pdf (511KB)
- Offline Documents: docs

Activity #1-2: Lack of Systematic investigation (Fiscal Year 2021)

Methods of experimentation:

[99] ....accorded with the total discipline of the scientific method. The Appellant simply did not adduce sufficient evidence to meet this criterion.

[100] According to the Timeline, the Appellant identified uncertainties with respect to the squat formulas and identified as well the potential solutions and the final accepted solutions.

Even though the Timeline mentions that Indusol was requested to conduct research and testing on board vessels, there is no information on what tests and research were actually carried out.

[101] Mr. van Eijle's testimony about how Indusol tested the proposed solutions and what the results of the tests were was also very vague. For example, with respect to calculating the additional squat when two ships approach each other in a channel, Mr. van Eijle testified that

"since we don't know exactly what it is, we, out of testing, created a table with speed ranges. . . . We went on board and measured and measured and measured. . . ." (Transcript of February 10, 2020, at p.101, lines 10-11, 21-22).

There was no evidence about any controlled experiments to test the proposed solution against empirical evidence.

With respect to calculating the speed of a ship taking into consideration the velocity of the current, Mr. van Eijle explained during the trial the solution ultimately arrived at, but there was no evidence as to whether systematic observation, measurement, and experiment were performed with a view to modifying the proposed solution which led to the final solution.

[115] ... to comply with the DIS implementation specifications. A series of conformance tests must be performed to demonstrate that the product meets the requirements in the specifications.

Exhibit A-12 documents the conformance testing procedures established for that purpose. This document does not record the hypotheses tested by Indusol and the test results.

It is merely a set of testing procedures that must be followed in order to determine whether a DIS conforms with the established standards.

[116] The Appellant also provided several charts which purportedly document work done by Indusol:

Exhibit A-6: Comments by Indusol Industrial Control Ltd. on Draft Working Document Version 1.00 (dated January 30, 2011)
Exhibit A-8: Comments on CD 1 of a Draught Information System for the St. Lawrence Seaway (dated January 18, 2011)
Exhibit A-9: Comments on CD 1 of a Draught Information System for the St. Lawrence Seaway (dated January 18, 2011, updated August 21, 2011)
Exhibit A-10: Resolution of Comments on CD 2 of a Draught Information System for the St. Lawrence Seaway (dated August 24, 2011)

[117] After reviewing those charts, I am not satisfied that they contain hypotheses tested and test results. The charts are records of Indusol’s comments on specific provisions of the draft DIS implementation specifications and the DIS conformance tests.

In some instances, the proposed changes to the provisions and the final decisions of the DIS Workgroup are included, but I do not find that any of the documents include hypotheses tested and test results.

Results:

Conclusion:

[102] For these reasons, I am not convinced that the procedure adopted by Indusol accorded with the total discipline of the scientific method. The Appellant simply did not adduce sufficient evidence to meet this criterion.

Therefore, for these reasons, I find that, on a balance of probabilities, the third criterion is not met.

[AUTHOR'S NOTE: COSTS ON THIS CASE AMOUNTED TO $ _______________ - CHECK WITH TAX COURT OF CANADA]

Uncertainty #2: Financial issues

The most significant underlying key variables are:

documentation of time vs. activities, is software eligible SR&ED material

Technology or Knowledge Base Level:

Activity #2-1: Tracking labour expenses (Fiscal Year 2021)

Methods of experimentation:

[135] In February 2013, the CRA requested details regarding the breakdown of the efforts devoted by the employees to the activities engaged in by Indusol during that year, and acknowledged the absence of timesheets to that point. The evidence showed that no such details were submitted to the CRA.

The Appellant could have used agendas, records, e-mail exchanges, notes and correspondence to reconstruct that information, as the CRA’s request was made less than a year after the end of the 2012 taxation year.

Results:

Conclusion:

[137] Here, Mr. van Eijle simply estimated the number of hours he and Ms. Clément worked during the 2012 taxation year and claimed that 75% and 50% of their respective time was devoted to SR&ED activities.

Since the Appellant's estimates are extremely general and were submitted without any evidentiary support, the salaries paid to Mr. van Eijle and Ms. Clément cannot be allowed as deductible eligible SR&ED expenditures and cannot be considered qualified expenditures for ITC purposes.

I find that the lack of evidence as to the time spent on various tasks is fatal to Indusol's claim.

Significant variables addressed: documentation of time vs. activities

Activity #2-2: Software as material cost? (NO) (Fiscal Year 2021)

Methods of experimentation:

[147] The Act does not define the words "materials" or "consumed". The principles of interpretation as set out by the Supreme Court of Canada are that the words of an Act ". . . 'are to be read in their entire context and in their grammatical and ordinary sense harmoniously with the scheme of the Act, the object of the Act, and the intention of Parliament' . . . The interpretation of a statutory provision must be made according to a textual, contextual and purposive analysis to find a meaning that is harmonious with the Act as a whole" (Canada Trustco Mortgage Co. v. Canada, 2005 SCC 54, at paragraph 10, [2005] 2 S.C.R. 601). The Supreme Court also indicates that when the words are precise and unequivocal, their ordinary meaning will play a dominant role, but if the words can support more than one reasonable meaning, the ordinary meaning of the words will play a lesser role.

[150] In Black's Law Dictionary (11th ed.), material is defined as "1. A solid substance such as wood, plastic, metal, or paper. 2. The things that are used for making or doing something. 3. Information, ideas, data, documents, or other things that are used in reports, books, films, studies, etc."

Results:

Conclusion:

[151] Given the ordinary meaning of the word material, which generally refers to elements from which something is made, I find that the Licence cannot be considered as a "material".

The Licence was used by Indusol to help with software development and hence is not an element from which something is made.

Given my conclusion in respect of the word material, I do not have to consider the meaning of the word "consumed". Therefore, the cost of the Licence cannot be claimed by Indusol under paragraph 37(1)(a) as a current expense as a cost of materials consumed in the prosecution of SR&ED.

Significant variables addressed: is software eligible SR&ED material

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
deterministic and stateful client-side control. (0 = no 1 = yes)	0	1	Yes
develop pivot output mechanism (0=no 1 = yes)	0	1	Yes
response time (seconds)	10	5	Yes

This project example is based on the Tax Court of Canada judgment for National R&D Inc. v. The Queen (2020 TCC 47).

[1] National Research & Development Inc. (“National”), a Canadian-controlled private corporation, which was incorporated on January 1, 2011, provided consulting services to clients in the areas of engineering, information technology, scientific research and experimental development tax credits and Ontario interactive digital media tax credits.

[2] For the 2011 taxation year the Minister disallowed the claim made by National for the expenses it incurred with respect to the PTS Project, totalling $68,029, claimed as SR&ED expenditures as well as the investment tax credit (“ITC”) of $23,810. [AUTHOR'S NOTE: UNDER $25K INFORMAL LIMIT BUT CLIENT ELECTED FULL PROCEDURE.]

[3] During the 2011 taxation year, the sole shareholder and president of National was Mr. Amit Saini. Mr. Saini was the only witness at the hearing. He was directly involved in the PTS Project as he conducted the activities himself, with the help of a student. Mr. Saini was accepted by the Court as a “litigant expert” (Kaul v. The Queen, 2017 TCC 55, at para. 32).

[4] Mr. Saini obtained a Bachelor of Engineering degree from McMaster University in 2003 and got his professional engineering license in 2007. He also obtained a Master of Business Administration degree (MBA) from Wilfrid Laurier University in 2010, a Certified Management Accounting (CMA) designation in 2011 and a Chartered Professional Accounting (CPA) designation in 2012.

Before founding National, he was employed by Meyers Norris Penny from April 2010 to March 2011 as a SR&ED manager. From July 2006 to April 2010, he was employed by ATS Automation Tooling Systems as a senior SR&ED specialist.

Prior to that (2006), he had worked as a manufacturing engineer and product manager at Precision Resource Inc. and in these capacities he was responsible for identifying and tracking SR&ED projects, and he had developed a web-based inventory system using ASP and SQL Server 2000.

OBJECTIVES:

[22] The first phase of the PTS Project, which was carried out during the 2011 taxation year, involved establishing an efficient and concise time-tracking system, and it had three sub-objectives (hereinafter collectively referred to as the “Objectives”):
1. To develop techniques for record set paging, sorting, and indexing that were compatible with the MTA (“Objective 1”);
2. To develop a mechanism for in-memory array initialization of joint record sets such as “pivot-like output” (“Objective 2”); and
3. To develop methods for deterministic and stateful client-side control (“Objective 3”).

Field of Science/Technology:

Computer sciences (1.02.01)

Project Details:

Intended Results:	Develop new materials, devices, or products
Work locations:	Commercial Facility
Key Employees:	Amit Saini (Mechanical - BEng, PEng. (2003) / CEO)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Project planning documents; Design of experiments

Scientific or Technological Advancement:

Uncertainty #1: paging, sorting & indexing method

[29] Mr. Saini's testimony was clear in that the PTS Project was to be developed through the MTA.

The MTA consisted of ADO, Classic ASP, COM+ and SQL Server 2000. Mr. Saini had determined that SQL Server 2000 would be used for that purpose and not SQL Server 2005. Furthermore, the framework of the PTS Project had to be web-based, cross-platform and cross-browser compatible.

The fact that SQL Server 2005 existed and had a PIVOT command at the time is not relevant for the purpose of determining whether the activities undertaken by National qualify as SR&ED.

[34] As a preliminary step or as the work was progressing, Mr. Saini examined various technical articles, copies of which were adduced in evidence, to determine whether it was possible to achieve the objectives of the PTS Project within the MTA.

[35] In respect of Objective 1, Mr. Saini testified that he conducted internet research and as a result consulted three articles, namely: “Efficiently Paging Through Large Result Sets In SQL Server 2000” (Exhibit A-4, at p. 41), “SQL Server 2000 Paging and Sorting Using ROWCOUNT And SQL_VARIANT” (Exhibit A-4, at p. 46), and “Efficient Paging of Recordsets: SQL Server 2000” (Exhibit A-4, at p. 53).

[36] Mr. Saini testified that solutions described in these articles would not work within the MTA for various reasons.

Some of the methods described did not return results reliably or efficiently. Additionally, one of the methods described only worked in static environments (the environment for the PTS Project needed to be dynamic).

After reviewing the above-mentioned articles, Mr. Saini concluded that there was no existing method that he could use within the MTA that met all of National's criteria.

[39] Mr. Saini testified about the technological uncertainties in the PTS Project and to the fact that no similar program already existed. According to Mr. Saini, the technological uncertainties were as follows:

i) For Objective 1: how to achieve paging, sorting and indexing of large data sets within the MTA with a maximum response time of 5 seconds;

[40] The Minister made assumptions that there were no technological uncertainties in any of the Objectives and that the activities undertaken by National could have been performed by the application of existing well-known information technology techniques.

The most significant underlying key variables are:

MTA limitations of framework, ADO, Classic ASP, COM+ and SQL Server 2000

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	3 Articles	[35] In respect of Objective 1, Mr. Saini testified that he conducted internet research and as a result consulted three articles, namely: “Efficiently Paging Through Large Result Sets In SQL Server 2000” (Exhibit A-4, at p. 41), “SQL Server 2000 Paging and Sorting Using ROWCOUNT And SQL_VARIANT” (Exhibit A-4, at p. 46), and “Efficient Paging of Recordsets: SQL Server 2000” (Exhibit A-4, at p. 53).
Competitive products or processes	3 products	[33] Mr. Saini testified .. In 2011, there was no web -based program that would allow for time tracking of SR&ED projects. QuickBooks Online can be used nowadays, but Mr.

		Saini testified that back in 2011 in its infancy functionality limited. Other programs Kashoo & R&D Manager too rudimentary to meet National's needs.

Activity #1-1: techniques for paging, sorting & indexing (Fiscal Year 2021)

Methods of experimentation:

Method	**Experimentation Performed**
Trials:	50 runs / samples

[23] Work was performed under Objective 1 to develop techniques for record set paging, sorting and indexing that were compatible with ADO, Classic ASP, Com+ and Microsoft SQL Server 2000. According to Mr. Saini, it was necessary to efficiently sort through the data, to push it from SQL Server 2000 through the MTA to the browser incrementally and then to display very quickly only data relevant to a particular client. Work undertaken to achieve this objective involved trying to overcome the paging limitations of SQL Server 2000 using "DataGrid" and "GridView" in ASP. Mr. Saini also testified that he tried using the ASP response buffer to incrementally push the data to the browser, but that method did not work. Other techniques that Mr. Saini attempted which were not successful include using "GetRows" in ADO and using temporary tables to achieve pagination. Eventually, the work undertaken resulted in the creation of what Mr. Saini referred to as the "Stitching Mechanism", a piece of code which allowed SQL statements to be constructed dynamically and allowed simple queries which utilized single-column sorting to return results. That technique was further refined and eventually some success on this point was achieved. According to Mr. Saini, the Stitching Mechanism which utilized dynamic SQL was an invention developed by National, but National was only partially successful in attaining the results desired under Objective 1.

ISSUES RELATED TO SUPPORTING DOCUMENTATION:

[50] Various documents were tendered in evidence by Mr. Saini, which, according to him, show that the scientific method was followed in developing the PTS Project. These documents are

the Project Timeline,
the Letter,
a document titled "Trials to Achieve Sorting & Paging With Set Constraints" (Exhibit A-7) and
various pieces of source code for portions of the PTS Project.

[51] According to Mr. Saini, the Project Timeline contains the details of the activities undertaken and the time spent on each of the activities and was completed as the work was being done. Mr. Saini also testified that it represents the hypotheses National was testing as the coding was being completed.

[52] However, upon reviewing the Project Timeline, I do not agree with Mr. Saini's position.

The Project Timeline lists vague descriptions of the work being completed and some of the specific problems National was trying to overcome along with a corresponding time entry.

While I have found that there was enough evidence to support a conclusion that there were, in fact, hypotheses, this document does not show the formulation, testing and modification of these hypotheses.

Further, there does not seem to be a logical progression between any of the entries in the document.

The Project Timeline does not indicate how any hypotheses were tested and does not list any experimentation or the results of any experimentation.

In addition, there is nothing in this document to indicate that any hypotheses were modified as a result of experimentation.

[53] The Letter is more substantial than the Project Timeline. For Objective 1, the Letter specifies that hypotheses were formulated, that over 50 experiments were conducted and that the hypotheses ultimately proved to be correct.

The Letter also references the document titled "Trials to Achieve Sorting & Paging With Set Constraints" (Exhibit A-7), which is a table outlining 50 experiments and their outcomes.

I do not find this table very helpful.

Several of the experiments are grouped together;

what is being tested is unclear;

how testing is being conducted is also unclear; and

the results listed are vague.

Furthermore, there does not appear to be any reference to the testing or modification of the hypotheses.

No similar document was adduced in evidence with respect to Objectives 2 and 3.

Results:

- response time: 5 seconds (100% of goal)

[63] More specifically, with respect to Objective 1, Mr. Saini testified that the technological advancement had been the development of the “Stitching Mechanism” which made it possible to achieve that Objective.

Conclusion:

TECHNOLOGICAL ADVANCEMENTS CLAIMED

[62] Mr. Saini testified that there was technological advancement in relation to the Objectives of the PTS Project. Specifically, he testified that National invented “Dynamic SQL”.

Further, many steps were taken with a view to attaining each objective, even if they were not all successful.

JUDGE'S ANALYSIS

The judge reviewed the eligibility using the 5 questions cited in the Northwest Hydraulics Case.

1- Was there a technological risk or uncertainty which could not be removed by routine engineering or standard procedures?
2- Did the company formulate hypotheses specifically aimed at reducing or eliminating the technological uncertainty?
3- Did the procedure adopted accord with the total discipline of the scientific method, including the formulation, testing and modification of hypotheses?
4- Did the process result in a technological advancement?
5- Was a detailed record of the hypotheses tested, and results kept as the work progressed?

The judge then further parsed question 2 into several subquestions

[45] As indicated by Justice Bowman in Northwest Hydraulic (at para. 16), the second criterion, i.e., the formulation of hypotheses aimed at reducing the technological uncertainties, involves a five-stage process:

i) The observation of the subject matter of the problem;
ii) The formulation of a clear objective;
iii) The identification and articulation of the technological uncertainty;
iv) The formulation of a hypothesis designed to reduce or eliminate the uncertainty; and
v) The methodical and systematic testing of the hypothesis or hypotheses.

[47] Given the testimony of Mr. Saini and the documents referred to above and adduced in evidence at the hearing, I find, on a balance of probabilities, that National did formulate hypotheses specifically aimed at reducing or eliminating the technological uncertainties raised by the PTS Project.

However, as indicated below under the analysis of the third criterion, Mr. Saini failed to convince me, on a balance of probabilities, that methodical and systematic testing of the hypothes was conducted by National.

Accordingly, the second criterion is not met as it requires the methodical and systematic testing of the hypotheses.

Significant variables addressed: ADO, Classic ASP, COM+ and SQL Server 2000, MTA limitations of framework

Documentation:

- Uploaded to RDBASE.NET: National R&D SRED tax ruling - SI & SRED software - LOSS.pdf (257KB)

- Offline Documents: nature of documents

Uncertainty #2: develop pivot table mechanism

[39] Mr. Saini testified about the technological uncertainties in the PTS Project and to the fact that no similar program already existed. According to Mr. Saini, the technological uncertainties were as follows:

For Objective 2: how to develop a pivot table reporting in a cross-platform and cross-browser environment;

[37] In respect of Objective 2, Mr. Saini testified that he also conducted internet research, and he referenced one article entitled: “Pivot and Un-Pivot data in SQL” (Exhibit A-4, at p. 82). According to Mr. Saini, the method described in this article only works in a static environment, and was not suitable for National’s needs.

Mr. Saini testified that at that time pivot tables were not available in an application that was accessible through a web browser and that pivot tables had definitely not been used in combination with anything similar to the MTA.

Mr. Saini also researched the PIVOT command available in SQL Server 2005 and concluded that it would not solve the problems encountered by National. Mr. Saini testified that the PIVOT command was only available in SQL Server 2005, and not in SQL Server 2000, which is a different version of the program than the one National was using.

Further, the PIVOT command only worked in SQL Server 2005, and was not necessarily compatible with the other components of the MTA. Finally, National had already purchased SQL Server 2000 and did not have the means to purchase SQL Server 2005. Furthermore, Mr. Saini did not think that the PIVOT command in SQL Server 2005 would even achieve National’s objectives.

[40] The respondent (CRA)... argued that the PIVOT command in SQL Server 2005 would have accomplished Objective 2, and that this was a generally accepted method used by professionals in the area at the time the activities in respect of the PTS Project were undertaken by National.

The most significant underlying key variables are:

static vs.dynamic environment (unresolved), web browser deployment methods

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	[37] article entitled: “Pivot and Un-Pivot data in SQL” (Exhibit A-4, at p. 82). According to Mr. Saini, the method described in this article only works in a static environment, and was not suitable for National’s needs.
Suppliers	1 products	the PIVOT command only worked in SQL Server 2005, and was not necessarily compatible with the other components of the MTA. Finally, National had already purchased SQL Server 2000 and did not have the means to purchase SQL Server 2005. Furthermore, Mr. Saini did not think that the PIVOT command in SQL Server 2005 would even achieve National’s objectives.

Activity #2-1: pivot output mechanism (Fiscal Year 2021)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	5 alternatives
Trials:	3 runs / samples

[24] Work was performed under Objective 2 to develop a mechanism, such as a “pivot-like output” for in-memory array initialization of joint record sets.

The goal was to emulate pivot tables, which is a reporting mechanism in Microsoft Excel that aggregates and summarizes data, but to do so in a web-based program.

Mr. Saini testified that he knew that SQL Server 2005 had a PIVOT command, but that it was not advanced enough to meet the objectives of National. However, National still tried to emulate the functionality of the PIVOT command in SQL Server

2000. National encountered numerous problems and was unable to effectively emulate the PIVOT command in SQL Server 2000.

After attempting other methods that were also unsuccessful and in a final attempt to achieve Objective 2, National tried to integrate SQL Server 2000 reporting services, but this method encountered compatibility issues with portions of the MTA and did not work. Ultimately, this objective was unsuccessful and was never achieved.

Results:

- develop pivot output mechanism: 0 0=no 1 = yes (no improvement)

[63] With respect to Objective 2, Mr. Saini testified that the experiments conducted did not bring the results anticipated, as National was unsuccessful in meeting the Objective.

Conclusion:

TECHNOLOGICAL ADVANCEMENTS CLAIMED

[63] With respect to Objective 2, Mr. Saini testified that the experiments conducted did not bring the results anticipated, as National was unsuccessful in meeting the Objective.

ISSUES RELATED TO SUPPORTING DOCUMENTATION:

[54] For Objective 2, the Letter states only that several experiments were done, but does not provide much detail on the number of experiments conducted, how experiments were conducted or the results of the experiments.

Moreover, the Letter does not specify how hypotheses were tested, nor does it specify if or how the hypotheses were modified as a result of the tests. All the Letter indicates is that the hypotheses were incorrect.

AUTHOR'S NOTE:

IT IS ALSO NOTED THAT USE OF "DYNAMIC VS. STATIC ENVIRONMENT" WAS CITED AS AN UNCERTAINTY HOWEVER, NO RELATED EXPERIMENTS OR CONCLUSIONS APPEAR TO BE PROVIDED ON THIS ISSUE.

Significant variables addressed: web browser deployment methods

Uncertainty #3: stateful client control

[39] Mr. Saini testified about the technological uncertainties in the PTS Project and to the fact that no similar program already existed. According to Mr. Saini, the technological uncertainties were as follows:

iii) For Objective 3: how to achieve “deterministic and stateful client-side control”.

[38] In respect of Objective 3, Mr. Saini testified that there was nothing available in the public domain that would allow National to obtain the desired results.

He referred to an article entitled: “What’s the difference between stateful and stateless?” but no copy of this article was tendered as evidence. Additionally, Mr. Saini testified that he conducted research on the internet to see if there was already a solution to the problem posed by Objective 3, but he did not find one.

The most significant underlying key variables are:

section variables and cookies (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	[38] Mr. Saini testified that there was nothing available in the public domain that would allow National to obtain the desired results. He referred to article entitled: “What’s the difference between stateful and stateless?” but no copy tendered as evidence. Additionally, Mr. Saini testified that he conducted

research on the internet to see if th

Activity #3-1: deterministic and stateful client-side control (Fiscal Year 2021)

Methods of experimentation:

Method	Experimentation Performed
Trials:	5 runs / samples

[25] Work was performed under Objective 3 to develop methods for deterministic and stateful client-side control.

National was trying to develop the ability to pass information from SQL Server 2000 through to the MTA and then to the browser in a manner that would make users believe that all of the previews for their choices were being generated instantaneously, when in fact the data was not pushed from SQL Server 2000 through the MTA to the browser until the actual choice was made.

In order to complete this objective, National tried a few different things. Mr. Saini testified that they first attempted to use section variables and cookies to store the information and make the process appear instantaneous, but that method did not work.

The second method that was attempted was to temporarily store the data at the browser level and to hide that data from the user. Since the browser was unable to store the required amount of data, this method was unsuccessful.

Finally, National developed the “handout” method, which involved a hybrid between ASP and JavaScript that performed recursive posts to the server. The “handout” method resulted in some success.

ISSUES RELATED TO SUPPORTING DOCUMENTATION (SOURCE CODE):

[55] For Objective 3, the Letter indicates that hypotheses were made and vaguely explains how the Objective was achieved. However, it does not explain what experimentation was conducted, how many experiments were conducted, or how the experimentation was conducted, nor does it set out the results in any detail. Additionally, the Letter does not specify how hypotheses were tested, or if they were modified as a result of the testing.

[56] Finally, the evidence adduced by National does include some source code.

[57] By reviewing these pieces of source code, I am not able to determine if they are early versions of the source code, or the final product. Mr. Saini did testify that he had different versions of the source code saved on a server at home, but these versions are not in evidence.

It is worth noting that “GRIDTIMEENTRIES.ASP” and “Gridtimentries.asp with ADO iteration” do at first glance appear to be related. However, no evidence was provided to show if or how these two pieces of code are related.

Additionally, there is no explanation regarding if or how experimentation was conducted in order to advance from one version to the other and which is the later version, nor is there any evidence as to whether or not the experimentation proceeded in accordance with the scientific method.

With respect to the other pieces of source code, I am not able to deduce a trend from a single data point and I do not see any evidence of an advancement of the source code nor is there any evidence as to whether or not it progressed in accordance with the scientific method.

Since I only have one version of most of the source code, and nothing to tell me if or how the other two pieces of source code are related, there simply is not enough evidence on the record to draw a conclusion on this point.

[70] As mentioned above, the evidence contains some pieces of source code.

If National had submitted a revision history - which it did not - or numerous versions of the same piece of code, it may have been possible to determine what tests were conducted and the results of those tests.

However, such is not the case: no explanation of any advancement in respect of the code was tendered as evidence, and I am unable to conclude that what was adduced in evidence is a detailed record of the testing and results.

Results:

deterministic and stateful client-side control.: 1 0 = no 1 = yes (100% of goal)

[26] The PTS Project never successfully achieved all of the Objectives, although, according to Mr. Saini, there was some degree of success on all three.

[63] with respect to Objective 3, National was able to come up with a viable solution using JavaScript.

Conclusion:

TECHNOLOGICAL ADVANCEMENTS CLAIMED

[62] Mr. Saini testified that there was technological advancement in relation to the Objectives of the PTS Project.

Specifically, he testified that National invented “Dynamic SQL”.

Further, many steps were taken with a view to attaining each objective, even if they were not all successful.

[63] with respect to Objective 3, National was able to come up with a viable solution using JavaScript.

[64] I find Mr. Saini’s testimony credible on this point. As a result, I find that there was some technological advancement in relation to the Objectives of the PTS Project, but not advancement within the meaning of the definition of SR&ED.

As mentioned above, in order to find that a technological advancement was achieved, I would have to first find that technological uncertainties were removed through a process of systematic investigation, which I do not.

Having concluded that National did not carry out systematic investigation to remove technological uncertainties, I cannot find that this criterion is met.

RULING & RATIONALE (LOSS):

[73] While it is not mandatory that the evidence be documentary, and testimonial evidence may be presented, I did not find that Mr. Saini’s testimony made up for the inadequacy of the documentary evidence.

Mr. Saini’s testimony did not detail the methodology behind the testing, how many tests were conducted with respect to each objective (other than Objective 1), how tests differed from other tests conducted or what the results of all of those tests were.

He testified regarding some of the problems National faced for each of the Objectives, but the explanations concerning the tests conducted were vague at best, and there was no discussion of specific measurable results.

From the explanations provided by Mr. Saini, I cannot conclude that there was a “logical progression between each test and preceding or subsequent tests”, and therefore I cannot conclude that National carried out a systematic investigation in respect of the PTS Project.

[74] National has failed to show, on a balance of probabilities, that the procedure adopted in the development of the PTS Project accorded with the total discipline of the scientific method, including the formulation, testing and modification of hypotheses, and that that process resulted in a technological advancement.

Further, National was unable to show that a detailed record of the hypotheses tested and results was kept as the work progressed. Therefore, the activities undertaken by National in developing the PTS Project do not constitute SR&ED.

[75] For these reasons, the appeal is dismissed, with costs to the Respondent.

[AUTHOR'S NOTE: RELEVANCE OF EXPERT WITNESS TESTIMONY]

[5] I [THE JUDGE] did not qualify Mr. Dowd, the expert hired by National for the purposes of this appeal, as an expert witness at the hearing. The Respondent did not call any witnesses.

PERHAPS BASED ON THE LACK OF DOCUMENTATION CITED THE JUDGE ELECTED NOT TO CALL ON THE TESTIMONY OF THE EXPERT WITNESS (MR. DOWD).

IT IS ALSO NOTED THAT USE OF "SECTION VARIABLES WITH COOKIES" WAS CITED AS AN UNCERTAINTY HOWEVER, NO RELATED EXPERIMENTS OR CONCLUSIONS APPEAR TO BE PROVIDED ON THIS ISSUE.

[AUTHOR'S NOTE: COSTS ON THIS CASE AMOUNTED TO $ ______________ - CHECK WITH TAX COURT OF CANADA]

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Throttling mechanism (KB)	500	64	No
Concurrency (users)	200	1000	No
supported hand held devices (number)	450	500	No
supported printers (number)	250	300	No

The following example is based on the Tax Court of Canada judgement ALLEGRO WIRELESS CANADA INC., and HER MAJESTY THE QUEEN, March 31, 2021

FACTS:

50] During the relevant years, the Appellant filed claims in respect of SR&ED performed on five separate projects.

1] The Appellant filed appeals in respect of three projects carried out in 2010 and the remaining project carried out in 2011.

2] The CRA accepted portions of 2010 Project 1 and Project 2 as SR&ED.

3] For 2010, the Appellant claimed SR&ED “ITCs” of $279,420 in respect of three projects.

The Minister disallowed $244,208 (87%) of the corresponding ITCs in respect of two projects.

4] For 2011 Taxation Year, the Appellant claimed SR&ED ITCs of $215,567.

The Minister disallowed $162,190 (75%) of the corresponding ITCs.

[101] the Appellant’s core product was its platform (software), which it built and constantly improved to accommodate the different idiosyncrasies of various hand-held devices, servers and printers.

Mr. Rupel (the Principal Investigator) testified that the Appellant was trying to develop products that would address issues that arose when dealing with the interactions of numerous complex systems.

At the time, its clients were using numerous hand-held devices and printers that were in the early stages of development.

It also had to design systems that operated with the various servers of its clients and recognize the different environments that each of its clients operated in.

Field of Science/Technology:

Telecommunications (2.02.07)

Project Details:

Intended Results:	Develop new processes, Improve existing processes
Work locations:	Research Facility
Key Employees:	Wesley Rupel (Allegro PI) (Physics - PhD (1985) / President & CTO), Gerald Penn (Allegro Expert Witness) (Computer Science - PhD (1991) / Expert witness)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Project planning documents; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Bug vs. Quirk vs. SR&ED

[28] The Appellant's core product was its platform (software), which it built to accommodate the different idiosyncrasies of the various hand-held devices used by its clients. The platform had to take into account the different operating systems and the frequent updates to the software controlling the low-level features of the devices. The Appellant's goal was to have one system that all the different applications used in the operation of the devices could be written to.

31] He noted that the Appellant did not have access to the source codes for the various underlying software that operated the hand-held devices. He referred to this software as a black box, something the Appellant could not see the "insides of". He noted that as the Appellant developed its various products, various bugs and quirks occurred.

BUGS:

32] Bugs arose when the underlying tools and software performed as expected and the Appellant made a mistake when writing its software, which it needed to fix.

QUIRKS:

33] Quirks arose when, after looking at the problem, the Appellant could not determine why the event was occurring. It did not make sense to the Appellant. In Mr. Rupel's words, there was something mysterious going on and it required a deeper investigation.

34] Mr. Rupel noted that a quirk may or may not end up on the Appellant's SR&ED claim.

The Appellant made the decision later, after it finished its investigation and hopefully found a solution to the quirk.

It would review the work it had done and determine whether it had conducted a significant amount of experimentation or whether the issue had been relatively straightforward and resolved in a direct manner.

In the latter instance, the work was not included in the Appellant's SR&ED claim.

The most significant underlying key variables are:

Bug vs Quirk, If Quirk - whether SR&ED?

Technology or Knowledge Base Level:

Activity #1-1: CRA approved doc system (Fiscal Year 2022)

Methods of experimentation:

DOCUMENTATION:

46] The Appellant also used bug/quirk tracking software: one called FogBugz and a second called Jira X. This allowed the Appellant to keep track of all bugs/quirks that were reported, when the bug/quirk was fixed and when a quality assurance team reviewed the fix.

47] With respect to determining when the work preformed with respect to quirks constituted SR&ED,

the Appellant, with the help of its Canada Revenue Agency ("CRA") SR&ED technical advisor, Mr. Paul Wong, had set up a system in the bugs/quirks tracking software (particularly Jira X).

This system allowed the Appellant to keep track of the problems it identified as quirks, the things that were not working the way the Appellant expected them to work. When the Appellant's developers were attempting to find a solution to a quirk, they would place information in the bug tracking software with respect to the work they were performing in an attempt to fix the identified quirk.

Results:

Conclusion:

208] On the basis of the evidence just discussed, I have concluded that when the Appellant conducted the projects at issue, it formulated hypotheses specifically aimed at reducing the identified technological uncertainty, followed appropriate procedures on testing, including the formulation, testing, and modification of hypotheses, and maintained a detailed record of the hypotheses tested and results achieved as the work progressed.

209] For these reasons, the work performed by the Appellant on the projects identified by the CRA as

TA1/TO1 of 2010 Project 1 (SAMPLE PROJECT 2201, ACTIVITY #1),

TA1/TO1 of 2010 Project 2 (SAMPLE PROJECT 2202),

TA3/TO3 of 2010 Project 1 (SAMPLE PROJECT 2201, ACTIVITY #2) and

TA1/TO1 of 2011 Project 1 (SAMPLE PROJECT 2203)

constitutes SR&ED for purposes of the Income Tax Act.

The appeals from reassessments under the Income Tax Act with respect to the Appellant's 2010 and 2011 taxation years are allowed, with costs.

THE SPECIFIC DETAILS FOR EACH OF THESE PROJECTS IS PROVIDED IN PROJECTS 2201 THROUGH 2203.

Significant variables addressed: Bug vs Quirk, If Quirk - whether SR&ED?

Documentation:

Offline Documents: Docs

Uncertainty #2: Backgrounds of Witnesses

During the six days of hearings, the Appellant (Allegro) called three fact witnesses, Mr. Wesley Rupel, Mr. Khalid Eidoo, and Mr. Russell Roberts, and one expert witness, Doctor Gerald Penn.

PRINCIPAL INVESTIGATOR (PI)

8] Mr. Rupel described the Appellant's business and the various research projects. During the relevant period, Mr. Rupel and his business partner controlled the Appellant.

9] Mr. Rupel holds an undergraduate degree in physics and mathematics. In 1981, he started a combined Masters and Ph.D. program in physics at the University of California, Santa Barbara. He completed the Masters portion of the program, however in 1985, while his professor was on sabbatical, he took a break from the program and joined Dynamical Systems Research ("Dynamical"), a software start- up company located in Berkeley, California.

10] A year later Microsoft acquired Dynamical. The acquisition allowed Microsoft access to Dynamical's software, which it used when creating the Windows operating system.

11] Mr. Rupel's work at Microsoft focused on increasing the speed of the Windows operating system, which was a significant issue since the first version of the operating system was extremely slow.

12] Mr. Rupel left Microsoft in 1992 and, in his own words, basically retired. He returned to Microsoft in 1998. He joined the Appellant in 2002 and became President and Chief Technology officer in 2004.

The Respondent (CRA) called one fact witness, Ms. Cathy Sporich, and two expert witnesses, Doctor Shrinavensen Keshav and Doctor Shirook Ali. I found all four fact witnesses to be credible.

EXPERT WITNESSES:

67] The test for admissibility of expert opinion evidence is a two-step test as set out by the Supreme Court of Canada in White Burgess Langille Inman v. Abbott and Haliburton Co., 2015 SCC 23 ("Inman"). Inman confirms and clarifies the common law principles previously described by the Supreme Court of Canada in R. v. Mohan, [1994] 2 SCR 9 ("Mohan").

68] The first step of the test requires the party putting the proposed expert forward to establish that the evidence satisfies the following four threshold requirements (the so-called Mohan factors):
- Relevance;
- Necessity in assisting the trier of fact;
- The absence of any exclusionary rule; and
- A properly qualified expert.

69] The second step requires the trial judge to conduct a cost-benefit analysis to determine if otherwise admissible expert evidence should be excluded because its probative value is overborne by its prejudicial effect. This requires the trial judge to consider such things as consumption of time, prejudice and the risk of causing confusion.

The judge only relied on the expert evidence of Doctor Penn.

The most significant underlying key variables are:

Relevance, Necessity, Proper qualification, Cost vs. benefit, Exclusionary rules (unresolved)

Technology or Knowledge Base Level:

Activity #2-1: Roles of Expert witnesses (Fiscal Year 2022)

Methods of experimentation:

5] During the six days of hearings, the Appellant called three fact witnesses, Mr. Wesley Rupel, Mr. Khalid Eidoo, and Mr. Russell Roberts, and one expert witness, Doctor Gerald Penn.

The Respondent called one fact witness, Ms. Cathy Sporich, and two expert witnesses, Doctor Shrinavensen Keshav and Doctor Shirook Ali.

JUDGE COMMENTS:

[99] After reading each of the export reports and hearing from the two experts, ... neither of the two experts called by the Respondent (CRA) had a sufficient understanding of the Appellant’s business, products or procedures that would allow them to give opinions that would help the Court.

Both Mr. Rupel and Doctor Penn testified that the difficult technological environment that the Appellant was attempting to operate in caused the various technological issues encountered by the Appellant.

Results:

6] I found all four fact witnesses to be credible. For reasons I will discuss, I have only relied on the expert evidence of Doctor Penn.

Conclusion:

JUDGE CONCLUDED:

[120] The Appellant was attempting to develop a new product (its platform) that would work seamlessly with a multitude of devices using different operating systems and operating on various client operating systems.

Neither Doctor Ali nor Doctor Keshav was aware of this difficult environment. As a result of this weak factual foundation, especially when compared to Doctor Penn’s factual foundation for his opinion, I have given no weight to the expert reports of Doctor Ali and Doctor Keshav.

The only expert report that I have placed any reliance on is the expert report of Doctor Penn.

Significant variables addressed: Cost vs. benefit, Necessity, Proper qualification, Relevance

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Maximum buffer use (K)	256	64	Yes
Fidelity (relevant info retained) (%)	100	90	Yes

The following example is based on the Tax Court of Canada judgement ALLEGRO WIRELESS CANADA INC., and HER MAJESTY THE QUEEN, March 31, 2021.

126] Project 1 as follows: “the implementation of a throttling mechanism to prevent overruns when sending more than 64KB across a Bluetooth printer connection (overcoming specific Bluetooth printing implementation limitations).”1

127] Mr. Rupel described in some detail the technological obstacles the Appellant had to overcome, the work it performed and the results it obtained with respect to the TA1/TO1 portion of 2010 Project 1.

128] He noted that the printers in questions were small printers that were used by approximately 20% of its clients and that hung on the belt of the client’s employees. The printers printed documents, such as receipts, based upon information that was transferred via Bluetooth from the hand-held device to the small printer. Microsoft wrote the software used to communicate with the small printer (referred to as the “Bluetooth stack”). The Appellant was not able to “look inside” the software to see how it worked or to adjust how it worked.

129] The problem the Appellant faced was that the small printers had a 64 KB buffer which stored the information sent from the hand-held device to the printer until the printer was able to use the information to print the document. The problem was that if too much information was sent, then the buffer was exceeded and some or all of the information was lost. This meant that its client could not get a proper printout of the document.

Field of Science/Technology:

Telecommunications (2.02.07)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Wesley Rupel (Allegro PI) (Physics - PhD (1985) / President & CTO), Gerald Penn (Allegro Expert Witness) (Computer Science - PhD (1991) / Expert witness)
Evidence types:	Progress reports, minutes of project meetings; Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

130] The fact that the Appellant’s different clients had Bluetooth stacks from different companies and printers and hand-held devices from different manufacturers compounded the problem. The Appellant needed to write software that would work on all of these systems.

131]Mr. Rupel noted that the problems placed the Appellant in a situation that was outside the bounds of normal engineering. He noted that with normal engineering one is working with systems that do not have buffer overruns, systems that work.

The Appellant was required to work with someone else’s system that had bugs and did not work properly, a system that was basically a black box.

The most significant underlying key variables are:

proprietary systems - blackbox issues, throttling - time vs. rate vs. % compression, transparent compression methods, “lossy

-type scenario" (less data), buffer overrun - speed vs. clearing

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	
Patent searches	5 patents	cholar&oq=(Maximum+buffer+use)+%26+bluetooth
Competitive products or processes	2 products	Based on prior work of Mr. Rupel as one of the original 10 developers in the Microsoft Windows team.
Similar prior in-house technologies	3 products / processes	The 3 current projects are all built upon Allegro core device management technology
Queries to experts	2 responses	Input from Dr. Russ Roberts (PhD) & Dr. Gerald Penn (PhD)

Activity #1-1: year 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	14 alternatives
Trials:	6400 runs / samples

132] Mr. Rupel stated that the Appellant experimented with three different solutions to the problem, doing a "lossy-type scenario", using a transparent compression method and using a throttling mechanism.

He noted that the Appellant a "lossy-type scenario", using a transparent compression method and using a throttling mechanism. He noted that the Appellant was looking for creative solutions that would allow it to work around the problem while using the standard interfaces.

133] The "lossy-type scenario" involved sending less data in order to avoid exceeding the 64 KB buffer. Mr. Rupel explained that this meant that one does not have complete fidelity in the document being printed, in the sense that the information being passed to the printer is incomplete in some manner, which may be acceptable depending on the application. The document that is printed may not look as good as the original, but it may be acceptable to the user.

134] Compressing the data meant using one of numerous available methods. It appears that one of the methods the Appellant tried was to create a JPEG image. The JPEG image would have all the text that needed to be transferred but in a compressed format.

135] He noted that the Appellant tried to develop a transparent compression method. This meant that that the Appellant was trying to compress and then decompress the data without the intervening software being aware that this was happening.

It had to develop software to "dig" into different places in the Bluetooth stack to try to inject compression in a way that would avoid the 64 KB buffer overrun.

Results:

- Maximum buffer use: 62 K (101% of goal)
- Fidelity (relevant info retained): 83 % (170% of goal)

136] Neither of these methods proved to be successful. However, the Appellant was able to overcome the problem by developing a throttling mechanism. A throttling mechanism is a way to control the speed at which the data is being pushed through the system. Mr. Rupel noted that, through experimenting, the Appellant was able to find an optimum speed that allowed the Bluetooth printer to clear out its buffer fast enough that it would never overrun the buffer.

Conclusion:

138] Doctor Penn concluded that the work performed by the Appellant with respect to TA1/TO1 of 2010 Project 1 was experimental development and applied research.

140] His actual conclusions were as follows:
The application of throttling and compression can only be achieved by setting certain quantitative parameters that are inherent in these techniques, such as lengths of time and targetted transfer rates or percentages of compression.

While setting or optimizing the settings of these parameters for a fixed pair of devices could be considered routine in different circumstances, this project dealt with interoperability across a range of mobile devices that were not manufactured by Allegro.

I know of no readily assessable knowledge base, now or in 2010, with which Allegro's engineers could have set these parameters merely through due diligence. This was a painstaking, experimental diversion from ordinary software development activities that no reasonable software engineer would call routine.

141] (Judge then stated) Doctor Penn's opinion is an example of the importance of knowing the technological environment that the Appellant faced when conducting experiments in an attempt to improve its products.

Significant variables addressed: "lossy-type scenario" (less data), buffer overrun - speed vs. clearing, proprietary systems - blackbox issues, throttling - time vs. rate vs. % compression, transparent compression methods

Documentation:

- Offline Documents: docs

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Scalability (%)	(not set)	(not set)	No
Throughput (MB)	(not set)	(not set)	No
Reduce TCP timeouts (number)	(not set)	(not set)	No
Reduced data vs TCP (%)	60	55	Yes
supported devices (number)	500	500	Yes
Minimum timeout (minutes)	5	1	Yes

The following example is based on the Tax Court of Canada judgement ALLEGRO WIRELESS CANADA INC., and HER MAJESTY THE QUEEN, March 31, 2021.

TA1/TO1 of 2010 Project 2

142] As discussed previously, the CRA split the 2010 Project 2 into three components. Mr. Rupel explained to the Court a number of general terms/concepts that applied to the entire 2010 Project 2.

143] The technological objective of 2010 Project 2 was to:

. . . develop methods and techniques to improve the scalability and throughput of TCP (Transmission Control Protocol) services transmitted over IP (Internet Protocol) on cellular networks. In particular, the objective was to develop methods to enable more efficient streaming of digital audio, connection-handling mechanisms to translate UDP to TCP and reduce the overhead related to TCP timeouts.3

144] Mr. Rupel explained to the Court the meaning of UDP and TCP. He also explained what is meant by a load balancer, session control and caching.

145] He noted that TCP is a protocol for internet communication. TCP is built on top of the internet protocol and provides a reliable way for the vast majority of things on the internet to communicate.

146] UDP is another protocol that is also built on top of the internet protocol, similar to TCP. UDP is a very lightweight protocol when compared to TCP, but TCP does a number of things that are not done by UDP.

147] Mr. Rupel explained that when a large amount of data is being sent over the internet, it gets broken down into pieces (packets) and each packet is sent separately through the internet protocol.

148] He noted that the advantages of TCP include the fact that it guarantees that the packet of information sent over the internet actually arrives at its destination. If the packet does not show up at the destination, TCP sends a notice to the sender of the information identifying which packet did not arrive. It also has a feature that ensures that packets of data, once received, are placed in the correct order.

149] UDP does not have these features but since it does not have as much “overhead” it can be faster than TCP. The Appellant created a UDP protocol that allowed its clients to reduce their data usage on the wireless cellular networks, which significantly reduced the clients’ costs. Mr. Rupel emphasized that at the time the cost of bandwidth on cellular networks was very expensive.

150] When the Appellant created the UDP protocol, it worked very well, however at some point problems developed. It determined that the problems were being caused by the interaction between its UDP protocol and new firewalls that were being installed by its clients.

151] Another problem related to load balancers. Clients that had a large amount of traffic on their networks and multiple servers used these load balancers. The purpose of the load balancers was to balance the usage of each of the servers.

152] The Appellant encountered problems with the interaction of load balancers and session control. Session control refers to managing sessions between a server and a specific user (referred to as a client). Instead of the client having to send all of the same information repeatedly to the server, the server stores some of the information until the session is completed. This is referred to as caching. A problem arose when load balancers caused portions of the information transferred to be stored on different servers.

153] Because of these issues, the Appellant was required to abandon its UDP protocol. It then worked to develop a TCP protocol that would work better than its UDP protocol and still reduce the client's data usage.

Field of Science/Technology:

Telecommunications (2.02.07)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Wesley Rupel (Allegro PI) (Physics - PhD (1985) / President & CTO), Gerald Penn (Allegro Expert Witness) (Computer Science - PhD (1991) / Expert witness)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Design, system architecture and source code; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Byte array pool

154] Mr. Rupel discussed the portion of 2010 Project 2 identified by the CRA as TA1/TO1.

155] The Appellant's CRA filing described the technological advancement that the Appellant was trying to achieve with respect to the TA1/TO1 portion of the 2010 Project 2 as follows,

"the implementation of a non-disposable byte array pool

into which digital audio was compressed for transmission

completely eliminating audio breakup caused by buffer under runs

(the under runs were in turn caused by insufficient packet throughput)."

156] When switching from a UDP protocol to a TCP protocol the Appellant encountered a problem with audio files.

They were not being sent fast enough and only a portion of the audio file could be played when first accessed by the recipient of the audio files.

The most significant underlying key variables are:

causes low package througput (unresolved), unsafe attributes checking vs speed, parameters relevant to digital audio transmission, eliminating buffer under runs

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	20 Articles	Client searches did not yield any existing library of required info.

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	3 alternatives
Trials:	14000 runs / samples

156] When switching from a UDP protocol to a TCP protocol the Appellant encountered a problem with audio files. They were not being sent fast enough and only a portion of the audio file could be played when first accessed by the recipient of the audio files.

157] The Appellant began experimenting with different ways to compress the audio files. At first, the methods it tried were not successful.

158] It then began experimenting with what is known as unsafe attributes. Mr. Rupel explained that the software language that the Appellant was using had a managed environment. Basically, it ensured that the various source code being used operated properly. However, the code used to do this slowed things down.

159] The Appellant tried writing so-called unsafe attributes by adding code that was not going to be managed. Mr. Rupel described the effect of unsafe attributes as follows:
. . . You don't have a safety net underneath you anymore, you're walking across the tightrope hoping that you don't have any bugs at that point because if you do it's not going to catch them, it's not going to prevent you from hurting yourself.5

160] He noted, however, that it resulted in less overhead, which meant that the Appellant could hopefully push data through quickly enough to solve the problem.

Results:

- Reduced data vs TCP: 52 % (160% of goal)
- supported devices: 500 number (100% of goal)
- Minimum timeout : 2 minutes (75% of goal)

161] The use of unsafe attributes did not work. The ultimate solution involved going back into the so-called managed world and using a hybrid solution where the Appellant was "doing things that [were] a little bit unsafe but not particularly unsafe."

162] Mr. Rupel provided a detailed technical description of the solution. It involved reusing certain of the objects that had been transferred. This saved enough overhead that the Appellant was able to solve the problem with the audio files. The solution worked for whatever audio was sent and on the approximately 500 different devices it encountered.

Conclusion:

165] In his expert report, he (Dr. Penn) stated the following:

. . . Programming with audio is a very niche expertise that most software engineers lack. This observation, combined with the increasing demand for smartphones over the last seven years, has led to a commodification of audio processing hardware and audio processing APIs within the mobile device industry that has greatly consolidated during the interval.

In 2010, however, there was still a considerable variance among handheld mobile devices in the range of supported audio formats, audio codecs, available audio transfer rates and supported functionality for audio in vendor-supplied APIs.

In the present component, these audio-specific parameters were underlying technological uncertainties in an ecology of foreign devices that Allegro's platform developers would have had to adapt their product to. ...characterizing the distribution of parameters relevant to digital audio transmission in 2010,

Significant variables addressed: eliminating buffer under runs, parameters relevant to digital audio transmission, unsafe attributes checking vs speed

Documentation:

- Offline Documents: docs

Uncertainty #2: Synchronous event wrapper

TA3/TO3 of 2010 Project 2
166] The Appellant's CRA filing described the technological advancement that it was trying to achieve with respect to the TA3/TO3 portion of 2010 Project 2 as follows: "The development of an [sic] synchronous event wrapper capable of timing out a process quickly, eliminating an average wait of 5-8 minutes for a TCP timeout from a mobile device".10

167] Mr. Rupel explained what a synchronous event was by distinguishing between a synchronous event and an asynchronous event.

A synchronous event occurs when, in the course of communication, the system sends a request for information and then waits until it receives the answer.

An asynchronous occurs when the systems sends a request for information and then does other things while another part of the system waits for the answer.

168] Mr. Rupel noted that with a synchronous event the whole system is waiting for the response and with an asynchronous event it is not waiting for the response. The synchronous method is used when the system cannot move forward in the logic of the program until the system receives an answer.

169] The problem the Appellant faced was that Microsoft had built a five-to-eight- minute timeout into its software that controlled the low-level features of the hand- held devices. The Appellant had no control over this timeout. Problems occurred in the TCP communication when a request was going out for information and no information was coming back. The Microsoft software would then take at least five to eight minutes to reset. This was a problem for the Appellant, which was trying to make devices that worked in real time, i.e., were always connected to the network.

170] Mr. Rupel described the problem as a software problem that occurred because Microsoft developed the software using protocols from a wired network and the devices were now being used on a wireless network.

He noted that the designers of the software never envisaged a situation where the device would be connected but could not send data, but this is a common occurrence for a device on a wireless network. An example of this type of situation is when a device is taken into a parking garage with poor reception.

171] While it was a design feature of the Microsoft software, the Appellant had to fix the problem without access to the code used by Microsoft, while operating in a very complex system.

The most significant underlying key variables are:

sync vs async events, redesign legacy hardwire code for wireless, firewall and deep packet inspection, packet loopback process, parallel session process

Technology or Knowledge Base Level:

Activity #2-1: Supporting Activity (Fiscal Year 2022)

Methods of experimentation:

172] Mr. Rupel described three methods that the Appellant tested in an attempt to solve the problem.

173] The first method involved using a firewall and deep packet inspection to terminate long-running connections that were waiting for a response. The Appellant was trying to deal with the situation where the software would tell it that it was connected, but there was actually a problem and the device was not communicating.

174] He explained that deep packet inspection meant that the Appellant was “peeking” into places that it would not normally be expected to go, namely the network buffers where the information was coming in through the TCP network.

175] Since the firewalls monitored the system traffic and knew exactly what was passing through the network, the firewall could be used to find information on what was going through the network.

176] Testing using the deep packet inspection and firewalls did not lead to a solution to its problem.

177] The second method it tried involved experimenting with a loopback process which involved sending a packet out through the networking layers with instructions that the place it should go is back to the point where it originated.

178] It hoped to avoid the five-to-eight-minute timeout problem by killing the network session, which, theoretically, would cause everything to immediately reset.

The problem it encountered was that it was only able to kill one side of the session (such as the device side) but was not able to kill the session on the other side (the server side). This left the system in what Mr. Rupel referred to as an inconsistent state, which caused a problem.

Results:

179] The problem was resolved by developing a two-pronged mechanism to eliminate the issue. Mr. Rupel described the process as follows:

. . . by creating another process we created a parallel situation where we could start a new session for -- the original session, which is where everything is still happening, all the important stuff is still going on there, but we create this other process that then creates a new session with the server, and then we have to basically keep track of what's happening over there but we can use that channel then to do our communication until that five-to-eight-minute timeout finally times out.

And so we have sort of a temporary communication channel that we set up during the period of time that the five-to-eight-minute window is blocking us.

Conclusion:

Doctor Penn's Opinion - SUPPORTING ACTIVITY VS. SEPARATE PROJECT

181] Doctor Penn does not believe that TA3/TO3 of 2010 Project 2 by itself constituted experimental development or research. However, he believes that TA3/TO3 supported the other parts of 2010 Project 2, which he believes constituted experimental development or research.

In effect the part of 2010 Project 2 that the CRA identified as TO3/TA3 supported the other portions of 2010 Project 2 in such a way that it contributed to the overall aims of an experimental development project.

He questioned whether it made sense for the CRA (or anyone) to split the Appellant's 2010 Project 2 into three components.

182] He stated the following in his expert report:
. . . This project's [2010 Project 2] description proposes one overarching technological advancement: a TCP-based application protocol that surpasses UDP in throughput and scalability. Whether or not this could be achieved was a technological uncertainty.

To achieve that advancement, there are certain design features of TCP that are inconsistent with its use in this application protocol. One of those, TO3, is the long timeout delays that are typically built into TCP stacks.

It is a defect of the subproject terminology, "TA3/TO3", that it implies such a limited scope of work as to preclude the identification of a TA or TU for just this one component. This component shares in the technological advancements and uncertainties of the project to which it contributes. . .

. . . I am unable to reasonably ascertain that a systematic investigation was conducted as part of this component's work on the basis of the documents and interviews available to me. I am, on the other hand, reasonably certain that Project 2 as a whole did consist of research and experimental development alongside some inevitable routine development that took place in support of the project's overall research programme. I also find it reasonably probable that the work described in TA3/TO3 and the associated technical content by itself was sufficiently novel to serve as the basis for a standardized extension to the TCP protocol for low-latency communication on unreliable networks. What is unclear to me is whether the realization of TA3/TO3's research potential in fact took place.

Significant variables addressed: firewall and deep packet inspection, packet loopback process, parallel session process, redesign legacy hardwire code for wireless, sync vs async events

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
distributed transaction timeout (1= yes/ 0 = no)	0	1	Yes
intelligent packet routing (yes = 1 / no = 0)	0	1	Yes

The following example is based on the Tax Court of Canada judgement ALLEGRO WIRELESS CANADA INC., and HER MAJESTY THE QUEEN, March 31, 2021.

58] Only the portion of 2011 Project 1 identified by the CRA as TA1/TO1 is before the Court. The CRA accepted that the portion it identified as TA2/TO2 qualified as SR&ED. The Appellant conceded during the hearing that the portion of 2011 Project 1 identified as TA3/TO3 did not constitute SR&ED.

TA1/TO1 of 2011 Project 1

183] The Appellant described the technological advancements it was trying to achieve for all of Project 3 as follows:

184] The technological objective of this project was to develop an integration platform for mobile devices that enables dynamic multiple endpoints.

Specifically, the objective was to develop methods to enable mobile data packets to be intelligently routed to different applications without the need for setting up specific end points or messaging agents for each integration point.

185] With respect to TA1/TO1 of Project 3, the Appellant hoped to achieve a technological advancement by developing a connection timeout mechanism for distributed transactions initiated by a mobile device.

Field of Science/Technology:

Communication engineering and systems (2.02.06)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Wesley Rupel (Allegro PI) (Physics - PhD (1985) / President & CTO), Gerald Penn (Allegro Expert Witness) (Computer Science - PhD (1991) / Expert witness)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: necessary wait times

185] The technological obstacle the Appellant faced was related to mobile transaction timeouts. The Appellant noted that the main purpose of its system was to provide data to client devices such as mobile devices. This required data to be sent across high-latency cellular networks. Because of the latency of cellular networks, it is not easy to determine whether a connection has timed out.

186] Mr. Rupel noted that people confuse bandwidth with latency. Latency is another aspect of speed or timing. He noted that information may pass through a system at a high speed (high bandwidth) and still be delayed in arriving at its destination (high latency).

187] He explained that cellular networks are high latency when compared with wire networks.

In a cellular network,

“there’s a lot more handshaking that has to go on with decoding what’s in the radio waves and the layers of technology that has to filter through in order to just get where you’re going with it that initial delay is worse on a wireless network, especially on a cellular network.”

188] The timeout was the same as in 2010 Project 2, but the timeout in 2011 Project 1 caused a different problem.

Mr. Rupel explained that the Appellant’s system bundled up business logic messages and sent it through the system. As discussed previously, the messages are broken up into pieces and sent through in little packets, which are reconstructed on the other side.

The process has what is referred to as a queuing mechanism. The Appellant’s software handles what is in the queue to feed the information through the underlying black box and then reconstruct it on the other side. The timeouts were causing problems in the fidelity of the Appellant’s queuing process.

189] For example, the timeout may cause the system to reset. Once it resets it feeds all the information sitting in the queue into the system at such a fast rate that it overwhelms the device.

The most significant underlying key variables are:

filtering methods vs. latency vs. ..., timeout length vs. queuing mechanisms

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	Client could not find any libraries of necessary wait times for the proposed application.

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Trials:	1400 runs / samples

190] As a result, the Appellant had to conduct tests on application timeouts to determine the optimal timing.

Mr. Rupel noted that there are a lot of trade-offs in the timing in that if you make it too short, you have one set of problems, if you make it too long, you have another set of problems.

It was trying to find the “sweet spot”, complicated by the fact that it was working with black boxes and had no way to know if the individual problems that occurred on one extreme or the other were going to become unacceptable from a business standpoint.

Results:

- distributed transaction timeout: 1 1= yes/ 0 = no (100% of goal)
- intelligent packet routing: 1 yes = 1 / no = 0 (100% of goal)

Conclusion:

191] He (Dr. Penn) provided the following opinion in his written report:

. . . the development of a mechanism that waits a specified period of time before resetting a network connection is standard practice, and the experimentation required to set the wait time often involves only a trivial amount of experimentation. . . . however,

knowing how long to wait when developing a product within an ecology of foreign devices and on multiple cellular networks is not routine.

Allegro were building just such a knowledge base

[knowledge of necessary wait times]

that would have been of value to members of the broader community of mobile software developers, including those who had never intended to purchase Allegro’s products. This was the result of applied research.

Significant variables addressed: filtering methods vs. latency vs. ..., timeout length vs. queuing mechanisms

Documentation:

- Offline Documents: docs

Project Name:	Airzone One OVERVIEW (WINS 4/6 projects)	**Start Date:**	2022-02-01
Project Number:	2210	**Completion Date:**	2022-12-31

Project Details:

Scientific or Technological Objectives:

Field of Science/Technology:

Project Details:

Intended Results:
Work locations:
Key Employees:
Evidence types:

Project Name:	Airzone - WIN Optimizing Passive Monitoring of Low-Concentration Compounds	**Start Date:**	2022-02-01
Project Number:	2211	**Completion Date:**	2022-10-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Detectable compounds (number)	44	52	Yes
single protocol for 8 items (protocols)	8	1	Yes

The following example is based on the Tax Court of Canada judgement AIRZONE ONE LTD., and HER MAJESTY THE QUEEN, Feb 21, 2022.

[37] In prior years, Airzone had success in establishing a detection protocol for a suite of 44 types of airborne compounds that may be present in a home environment at low levels of concentration.

[38] According to Mr. Fellin, Airzone undertook the experimental work on this project to increase the range of detectable compounds from 44 to 52. Airzone did so to stay abreast of its competition in this highly specialized field.

Field of Science/Technology:

Meteorology, atmospheric sciences & climatic research (1.05.07)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Mr Fellin (Airzone) (Chemistry - BSc. (1972) / Airzone One President)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[39] To obtain reliable measurements of these additional eight compounds, Airzone believed that it could not rely on the extraction and identification protocol that it had established for the initial 44 compounds.

41] Extraction techniques are known to fail because compounds are not separated from each other in a way that allows for the measurement of the concentration levels of each compound.

After failing to obtain reliable data through a variation of extraction times, Airzone decided to test the hypothesis that a more polar solvent would improve measurement of the concentration levels of the additional eight compounds.

47] The evidence shows that standard methods, procedures and equipment may reach their detection limits when contaminants are present in low levels of concentration. Some compounds have similar attributes.

In other cases, the attributes of compounds in an air sample may be quite diverse. Extraction procedures can cause compounds to co-elute, which prevents reliable identification and quantification of each sample.

According to Mr. Fellin, this was the challenge that Airzone sought to resolve. An improved extraction and identification process was required. This new process could not be established without systematic scientific investigation.

49] Additionally, part of the uncertainty itself was creating a single protocol that could detect all 52 compounds. As Mr. Fellin explained, had Airzone used a separate device or protocol for the eight additional compounds, it would have doubled the cost for any potential client.

In this regard, rather than use a new solvent specifically for the eight additional compounds, Airzone purposely sought to modify the solvent used for its existing suite of 44 compounds. This came with its own host of challenges.

The previous 44 compounds were simple aromatic hydrocarbons. Therefore, they could all be treated in the same way. Conversely, the eight new compounds had different properties (such as polar groups). This meant that the different compounds could not be extracted from the same medium with the same efficiency.

Additionally, because the previously used solvent had been modified, Airzone had to adjust the chromatographic conditions for both the existing suite of 44 compounds and the eight new additional compounds. It was not simply a matter of adding new protocols to its existing methodology. Airzone had to develop a completely new protocol.

The most significant underlying key variables are:

extraction times, chromatographic variables, solvent polarity vs. aromatic hydrocarbons

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	5 Articles	46] Data on how to extract the full slate of compounds was not publicly available.
Suppliers	1 products	3M methodology referred to by CRA

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Trials:	10 runs / samples

40] Airzone first experimented with extraction times. The hypothesis that the work was conducted under was that the modification of the
solvent used to extract the additional eight compounds would compromise the analysis of the existing suite of compounds.

each set of tests for each compound included modifying extraction times, solvent mixtures, solvent modifiers (to alter polarity), and chromatographic conditions with different chromatography machines.
. . .

41] Mr. Fellin explained that Airzone, rather than replace the solvent that it typically utilized, experimented with modifying the solvent with additives to attain the desired extraction efficiency for the additional compounds while retaining detection efficiency for the other 44 compounds.

While this proved successful overall, further analysis of the experimental data led Airzone to conclude that butanol proved most successful because of the higher recovery efficiency. Airzone continued experimentation with a solvent combining carbon disulphide with 5% butanol to confirm that the solvent would work efficiently for the full suite of compounds.

42] Mr. Fellin indicated that additional experimentation was then necessary to adjust the chromatographic variables typically utilized to analyze each compound.

These variables include temperature, column length, column type, flow rate through the column, carrier gas, and injection volume.

Airzone carried out experiments with each variable to improve its detection abilities.

Results:

Detectable compounds: 52 number (100% of goal)

- single protocol for 8 items: 1 protocols (100% of goal)

CRA argument for denial:

43] After completing his technical audit, Mr. Melnyk recommended that Airzone's SR&ED claim be disallowed for this project for the reasons set out below

"The work involved optimizing established detection techniques and applying commercially available passive monitoring tools (3M brand) ....
methods rather than the development of new methodologies to detect each compound. ....

there was no generation of new scientific knowledge or advancement in technology related to airborne contaminant detection."

49] In the end, Airzone was successful, except for two compounds.

Conclusion:

Judges ruling & Rationale:

45] I was surprised when I read the CRA's reasons for disallowing Airzone's SR&ED claim considered in light of what CRA's published guideline describes as eligible experimental development. The most recent CRA guideline is dated August 13, 2021.

The "Why" requirement in the context of experimental development

46] .... There were too many variables or unknowns for Airzone to be able to accurately detect and measure the full slate of 52 compounds.

Data on how to extract the full slate of compounds was not publicly available. Airzone did not have this technical knowledge at the outset. It conducted tests to establish a reliable identification and quantification method.

Significant variables addressed: chromatographic variables, extraction times, solvent polarity vs. aromatic hydrocarbons

Documentation:

- Offline Documents: docs

Project Name:	Airzone - LOSS Solving Combustion Issues to Develop Artificial Smouldering	**Start Date:**	2022-03-01
Project Number:	2212	**Completion Date:**	2022-11-30

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
measure emissions (% expected)	(not set)	(not set)	No

72] During summer months, coal piles that were stored at a shipping terminal were prone to spontaneous smouldering. Airzone was engaged to identify and measure the compounds emitted from the smouldering coal piles.

Field of Science/Technology:

Environmental sciences (1.05.06)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Lab
Key Employees:	Mr Fellin (Airzone) (Chemistry - BSc. (1972) / Airzone One President)
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

72] The evidence shows that because of the risks associated with spontaneous combustion, neither Airzone nor its partner in this project could undertake direct sampling at the coal face using traditional monitoring to do so.

The most significant underlying key variables are:

identify compounds

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Trials:	25 runs / samples
Physical prototypes:	1 samples

73] Faced with this difficulty, Airzone decided that the identification and quantification of the compounds had to be measured in a testing device. Airzone designed a testing chamber and used that chamber to collect representative emissions from various types of stored coal.

The testing chamber that was designed for this purpose allowed oxygen delivered into the chamber to be controlled so that the smouldering process could occur over a two-hour period without full ignition of the coal. Oxygen levels were controlled to prevent full combustion of the coal.

Mr. Fellin explained that burning coal releases fewer emissions than smouldering coal because the fire itself consumes the contaminants typically released by smouldering coal.

75] a large part of the work undertaken in this project concerned the design of the testing chamber and the use of the chamber to mimic smouldering coal.

76] The smouldering process generated substantial water, which interfered with the measurement of other emissions by the continuous monitors. However, Airzone was nonetheless able to measure these emissions using different monitors, called integrated samplers.

Once the emission compounds were measured, Airzone used an existing computer model developed by the United States Environmental Protection Agency to estimate the level of exposure at various locations around the terminal.

Results:

JUDGE COMMENTS:

75] In my opinion, the testing chamber, although a little more sophisticated, was not that different from a home use barbecue.

Conclusion:

76] Secondly, unlike the three projects undertaken in 2014, there is no evidence in the record that shows that Airzone had difficulty establishing the identification and quantification of the emissions generated from different types of coal once the smouldering process was started.

I am of the opinion that Airzone has not demonstrated that the work undertaken in connection with this project was undertaken to achieve a technological advancement. Rather, I believe that Airzone knew what methods or processes could be used to mimic emissions from a smouldering coal pile and knew how to measure the emissions once the smouldering process was undertaken.

What Airzone did was measure emissions using standard methods and techniques typically employed when contaminants are released in a testing chamber.

Significant variables addressed: identify compounds

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Energuide efficiency rating (%)	80	90	Yes

The following example is based on the Tax Court of Canada judgement 6398316 CANADA INC operating as Global Sustainable, and HER MAJESTY THE QUEEN, Mar. 4, 2021.

1] determinations pertain to the Appellant's 2012 and 2013 taxation years... These claimed expenditures were incurred in connection with a construction project carried on by the Appellant during those two years. The construction was of a house, in southern Ontario, intended to be uniquely energy efficient while staying within the price range of a "regular home".

Evidence:

8] At the opening of the hearing, Appellant's counsel stated that his client's total of claimed SR&ED expenditures for the 2012 taxation year had now been reduced by $3,485.65 to the amount of $139,631.67; and likewise the 2013 taxation year total had now been reduced by $34,032.69 to the amount of $61,752.60.

9] The corporate Appellant called one witness – Mr. Cory Smith (CS). At all material times CS was the Appellant's president. Neither party called any expert evidence and the Respondent called no witnesses. CS

10] CS testified that he has experience in house construction and has earned various training certifications relating to house construction. They include a 2008 certificate from Sir Sanford Fleming College marking completion of a six month study program in "sustainable building design and construction".

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility
Key Employees:	Cory Smith (re. Global) (Home building - College certificate (2008) / President)
Evidence types:	Samples, prototypes, scrap or other artefacts; Photographs and videos

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

12] As a first step, the Appellant engaged a company knowledgeable in passive house design to render formal, computer software generated design plans for the small house.

13]These design plans were generated in full consultation with CS and allowing for elements and concepts he wanted included. CS testified that the aspects of the project upon which the SR&ED claim was based were various natural force interactions such as thermal mass, thermal bridging, passive cross-ventilation, passive heating and cooling, and air sealing.

Thermal mass is the ability to absorb and store heat energy – here in the building's concrete footings. In winter, warmer daytime temperature warmth would be released throughout the colder night.

Thermal bridging is the movement of heat across an object more conducive to that than surrounding materials. For example, warm air can relatively readily migrate though wood framing from indoors to outdoors, resulting in heat energy loss.

Passive ventilation is manipulating air movement within the building environment entirely or mostly absent the use of active ventilation sources, such as a furnace.

Passive cross-ventilation, a term coined by CS, refers he said to an even, passive distribution of hot air and cold air.

26] In oral submissions, Appellant's counsel addressed these two steps. He submitted,

The hypothesis is I can build a house that doesn't need a furnace, at a price point that's similar to a regular home.

That's the hypothesis and the technical [sic: technological] uncertainty is the cost. [

The most significant underlying key variables are:

effects of natural force interactions (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: House construction (Fiscal Year 2022)

Methods of experimentation:

A prototype house was built. A base design was purcahsed and then various decisions were made on levels of insulation and modifications of this base design.

Results:

- Energuide efficiency rating: 91 % (110% of goal)

24] The home as built received an "Energuide" efficiency rating of 91 out of 100. The Energuide document (Ex. A-17) provides inter alia that the "typical rating" for a "New house built to minimum building code standards" would be "65 to 70".

It provides that the typical rating for its top category, being a "Highly energy-efficient house", would be "80 or more".

Conclusion:

Judge's comments:

27] Thus the Appellant's position is not that there was any technological issue vis-à-vis the various aspects of construction referred to in CS's testimony in constructing this energy efficient home. And I would agree with that.

None of these various aspects, including extra insulation of the footings and foundation, walls and attic, extra taping of gaps and seams, and as well development of the modified ground loop as a cheaper and less energy efficient geothermal system, were described by CS as reflecting new technological knowledge. That is, none of these various aspects that CS testified to reflected development of technological knowledge new to the home construction industry.

28] Furthermore the Appellant presented no expert evidence as to the state of technological knowledge within this industry, that might suggest that the Appellant had broken new technological ground in constructing this energy efficient house.

No supposedly new knowledge was identified by CS, let alone by an expert witness, as having been sought or developed in the construction of this house.

COST AS A BASIS FOR ADVANCEMENT:

30] Conceptually there is no technological aspect implicit in the notion of an item costing or priced at 'x' rather than 'y' dollars. Of course one might envisage that the cost (or price) of an item could be reduced in the event of some particular technological advancement.

But the relevant question for SR&ED purposes would remain – what is that contemplated technological advancement itself, that could lead to the achieving the commercial objective of lowered pricing, comparable to that of standard code constructed housing.

Documentation:

- Offline Documents: docs

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Cost ($)	(not set)	(not set)	No
Performance (W/m2)	200	250	No
Snow load (kg)	(not set)	(not set)	No
Windload (km/h)	(not set)	(not set)	No

The following example is based on the Tax Court of Canada judgement, LOGIX DATA PRODUCTS INC.,and HER MAJESTY THE QUEEN, May 14, 2021.

1] The issue in this appeal is whether expenditures the Appellant, Logix Data Products Inc., incurred in its taxation year ending June 30, 2013 qualify as “SRED”.

The Appellant is an information technology services company.

2] The activity in question is work the Appellant undertook to develop what it describes as a dual purpose solar shingle – that is, a solar panel that could replace shingles. The concept is that the solar shingle would serve as a source of power and be mounted directly on the roof so that shingles would not be necessary.

Company Background:

28] The Appellant is an information technology services company that develops microcomputers, including for the fast food restaurant business (its original business), provides IT services (including computer hardware and software sales, network administration, and development of software and computer systems20), and provides internet services across Canada (i.e., is an internet service provider (ISP)).

29] Robert Baird is the President and CEO of the Appellant. In the early 80s, Mr. Baird started working in technology, initially as an employee of Pizza Pizza but then on his own as a sole proprietor, before incorporating the Appellant in 1986.

Initially the Appellant’s business was microcomputers but it expanded its offerings over the first decade of operation to include the other computer technology services it provides today.

The Appellant is not in the power business or the solar panel business. So how did the Appellant decide to pursue the development of a solar shingle?

Background to the Solar Shingle Project

31] Silfab S.r.l. (“Silfab”) is an Italy-based solar panel manufacturer that decided to establish a manufacturing plant in Canada. Mr. Baird explained that the Appellant was engaged by Silfab to work with it in an IT capacity, to develop Silfab’s IT infrastructure for its Canadian manufacturing plant.

The Appellant’s work commenced when the Silfab building in Canada was empty and carried on until Silfab produced its first solar panel in Canada.

Mr. Baird said that the Appellant continues to provide IT services to Silfab. Silfab produces solar panels for utility power generation at that plant.

32] Mr. Baird said that it was through the IT work with Silfab that he learned a lot about the design and production of solar panels, “basically how they work and what they are used for”.

Field of Science/Technology:

Electrical and electronic engineering (2.02.01)

Project Details:

Intended Results: Develop new processes, Improve existing materials, devices, or products

Project Name:	Logix Data (solar panels) - LOSS	**Start Date:**	2022-05-01
Project Number:	2216	**Completion Date:**	2022-10-31

Work locations: Research Facility
Key Employees: Robert Baird (Logix Data) (computer science - n/a (1986) / President)
Evidence types: Samples, prototypes, scrap or other artefacts; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Experience of People involved in the Solar Shingle Project

35] Mr. Baird said that he and three other employees of the Appellant were involved in the Solar Shingle Project.

36] Mr. Baird describes himself as a computer engineer. He holds certifications from several manufacturers of computer hardware and software systems but these are vendor or product specific qualifications.

Mr. Baird has not taken any programs or courses at college or university.

Mr. Baird has not taken any courses or training in engineering (including mechanical or electrical engineering).

Mr. Baird did not explain what it was about his experience working on the IT installation project that gave him the requisite knowledge.

37] Two of the other three individuals Mr. Baird described as involved in the Solar Shingle Project are IT technicians. The third is a sales consultant.

67] Appellant's counsel asked Mr. Baird to describe the uncertainties the Appellant faced. Mr. Baird suggested the following: Whether the solar shingles could be placed directly on the roof in place of shingles?

The durability of the solar shingle, i.e., would a smaller solar panel without a frame break because it had less rigidity and would moisture leak into the edge?

How would the power be "bussed out" of the shingles because smaller panels (i.e., shingles) required more panels to cover the same area as traditional solar panels requiring more connectors?

Whether the smaller panels (shingles) could achieve a target power yield of 250 watts per square meter given greater (non-productive) space needed to connect them together?

Whether the solar shingle could be scaled up in size and achieve the same results?

(i) What was the knowledge in the industry at the time?

74] What is particularly troubling is that the Research Summary suggests solar shingles did exist.51 Mr. Baird also described seeing Tesla advertisements for solar shingles. He said he did not believe they were available for purchase at the time, but rather were in development, expressing the view that the advertisements were intended to create demand in advance of the shingles actually being available.

Mr. Baird also suggested the picture in the Tesla advertisement implied a flexible solar shingle that, he said, is not as efficient as solid solar cells. He said when the Appellant commenced the Solar Shingle Project in 2011, there was no viable commercial product, though some enterprises were talking about it.

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

COMMENTS BY JUDGE:

107] The test description documents lack significant detail. None specifies the purpose of the test (what is the problem or technical uncertainty the test seeks to address) and none states a hypothesis. None states the observations made in, or conclusions drawn from, the prior version of a test which led to the revision.

None includes an explanation about why the proposed revision might assist with solving the observed problem.

108] There is no explanation of why the particular test equipment was selected, where measurements were to be taken, why the test was set up the way it was, how many times it was to be repeated,79 or over what period it was to be done.

109] In each case, the description of the test procedure lacks precision. Let me give some examples.

110] The list of equipment for Revision 1 and 1.1 of the thermal performance test includes volt meter, amp meter, resistor and digital thermometer.

None of this equipment appears on the schematic for the test, yet the test procedure instructions state little more than: set up test as outlined in drawing; using amp, volt meters and thermometer measure power output and temperature at 15 minute intervals until the single temperature ceases to increase; report results.

Nowhere does it specify how or where the measurements are to be taken.

Mr. Baird testified they discovered the shingle was hottest in the centre and so they decided to measure the temperature there, but that is not specified anywhere. Revision 1.1 (aluminum mesh) states nothing more than “Re-run tests using aluminum/rubber mesh backing sheet.” The details of that backing sheet are not described.

117] The wind resistance test equipment list includes edge clamps and a wind meter. Neither appears in the schematic yet the procedure refers to the schematic for test set up. The test procedure provides for testing at several wind speeds, but nowhere are the wind speeds indicated.

The test procedure does not specify the placement of the fan (distance from the shingle and/or centered or otherwise along the shingle edge).

In testimony Mr. Baird said that the schematic for the wind resistance test was not the correct perspective. If this is so, where is the set up explained? The test procedure states that effects on the shingle should be measured at the 0-25 mm gaps with the vernier. The nature of the measurements is not specified, although the vernier suggests deflection.

139] Finally, I note that the jurisprudence indicates that the documentation should be contemporaneous. The reasons are obvious. I confess that my impression is that the schematics and test descriptions the Appellant provided were not prepared before the tests were conducted, and as revisions were made, but rather subsequently when the CRA asked the Appellant for supporting documentation.

I have a similar impression of the Testing Summary. It appears to “lift” many of the point form notes from the meeting minutes and is undated. It was provided to the CRA after several requests for documentation. I am not convinced it was prepared in 2013 as the work was done.

Results:

Analysis of Expert Witness report:

14] The Amended Report is stated to be the expert’s “independent expert opinion on whether Project 1 constitutes scientific research and experimental development.” The opinion expressed is that:

Project 1 constitutes experimental development in the field of mechanical engineering specific to the semi conductor and photovoltaic industries that was performed by a competent researcher in this field.

15] With respect, this is not the purpose of an expert report. ...the expert’s role is limited to providing the court with a set of prescription glasses through which the technical information may be viewed before being analyzed and weighed by the trial judge.

16] Report states several opinions without explaining the facts and assumptions on which those opinions are founded8 or the reasons for the opinions expressed.

Nowhere in the Amended Report are the relevant facts and assumptions described. The Amended Report consists largely of conclusory statements - statements without explanation, context or support.

19] An expert has an overriding duty to assist the Court impartially. They must be independent and not be an advocate for a party.

Conclusion:

75] Mr. Baird acknowledged he did not contact Tesla or look at any online engineering forums to see what might have been developed or have been under development by Tesla or otherwise. He did not speak with the manufacturers, suppliers or installers of the solar shingles referred to in the Research Summary, any other manufacturers of solar panels, or any other experts in the field of solar energy.

The only people he said he spoke with were employees of Silfab, an enterprise that was neither manufacturing, nor interested in manufacturing, solar shingles.

His description of those conversations did not suggest a particularly robust inquiry about technological issues.

141] The Appellant bears the burden of establishing that it conducted activities that constituted SR&ED by leading evidence to rebut the Respondent's assumptions. It has failed to do so. Accordingly, the appeal is dismissed.

142] Costs of the motions and the appeal are awarded to the Respondent.

Documentation:

Offline Documents: docs

Project Details:

Scientific or Technological Objectives:

2] The appellant claimed two SRED projects that year, one entitled “Improved sealing between submerged, rough cast surfaces” and the other entitled “Pressure activated removable plugs for large box culverts.”

The Minister of National Revenue says that the activities relating to the second project did not meet the definition of SRED and therefore, disallowed the related SRED expenditures.

4] The appellant is part of the Borger Group of Companies, established in 1919. The appellant’s general manager Ahmed Kalaf testified that it specializes in deep utility servicing, earthmoving and more recently, transportation.

15] Mr. Kalaf testified that he has a Bachelor of Science degree earned in 2007 and acknowledged that he is not a civil engineer

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Improve existing materials, devices, or products
Work locations:	Commercial Facility
Key Employees:	Ahmed Kalaf (WD Borger) (? - BSc. (2007) / GM)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

6] Mr. Kalaf testified that culverts are generally installed above water level so in this instance, it was a particular challenge that the invert (i.e. the bottom of the interior) of the box culvert was approximately 4 metres below the pond’s surface. He explained that the pond water would exert a head pressure (i.e. pressure caused by its weight) on any blocking device they might use.

Therefore, the blocking device would have to be able to withstand 4 metres (i.e. 13 feet) of head pressure. He also stated that draining the pond was not an option in this instance because they were not permitted to disturb its vegetation.

He added that the base of the pond was also uneven because there was a layer of riprap, which is a rock product used to protect the pond’s inlets and outlets from erosion.

7] Another physical consideration was hoop stress, which Mr. Kalaf explained to be the stress exerted on a cylindrical device (i.e. in this case, the culvert itself and the inflatable bladder dam discussed below). For the purposes of this appeal, it is relevant that hoop stress is affected by the amount of pressure on the cylinder, the width of the cylinder, and the thickness of the cylinder wall; for example, thickening the cylinder wall lowers the hoop stress.

INDUSTRY STANDARDS:

8] Mr. Kalaf stated that the appellant made inquiries within their industry as to how/whether others had encountered this situation, as well as conducted internet research.

He testified that both lines of inquiry yielded minimal information, and that the appellant ultimately tried both a water-filled inflatable bladder dam (also known as an inflatable or portable cofferdam) as well as a rigid cap as blockage devices.

The most significant underlying key variables are:

water head pressure (unresolved), hoop stress (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

20] The appellant tried existing dewatering procedures in terms of the inflatable bladder dam and a rigid cap. The appellant ultimately used the concrete cap, inserted physical objects to block any remaining gaps, and controlled ongoing seepage by using pumps.

Results:

Conclusion:

Judges comments & ruling:

21] I would consider the use of physical objects and pumps in this manner to be within the scope of their standard usages.

22] As an example of trial and error, the appellant purchased the 8-foot x 50-foot inflatable bladder dam whose manufacturer's specifications indicated that it could control 6 feet of still water. The culvert itself was 2.4 metres x 2.4 metres (i.e. 7.8 feet x 7.8 feet) with 4 metres (i.e. 13 feet) of head pressure exerted by the pond water.

Even though the culvert's interior surface was not smooth, the appellant informed the seller that there were no objects present which could potentially damage the dam's interface.

Given these parameters and contraindications, it seems that success was very unlikely from the outset. The effort also did not reach the level of disproving a scientific hypothesis because the bladder dam was used for its created purpose (i.e. blocking water) and the variables exceeded the capabilities already set out by its manufacturer.

24] there was no advancement in the field of civil engineering for the purposes of the SRED provisions

25] The appeal is dismissed, without costs.

Documentation:

- Offline Documents: docs

Project Name:	Beton Workshop OVERVIEW (LOSS 2/2 projects)	**Start Date:**	2022-01-13
Project Number:	2220	**Completion Date:**	2022-08-30

Project Details:

Scientific or Technological Objectives:

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:
Work locations:
Key Employees:
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

The company claimed 2 projects however neither was found to have the required technological uncertainty or systematic investigation.

Technology or Knowledge Base Level:

Activity #1-1: lack of "systematic investigation" (Fiscal Year 2022)

Methods of experimentation:

Results:

Conclusion:

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Thickness (inches)	1	0.5	Yes
Strength (%)	100	100	Yes

The following example is based on the Tax Court of Canada judgement BETON WORKSHOP INC., and HER MAJESTY THE QUEEN, Jan 27, 2022.

e) the objective of the project claimed by the appellant was to manufacture transportable concrete panels, the thickness of which was to be reduced by half compared to that manufactured conventionally, and this:

without warping;

without generation of fractures;

with equal or greater compressive strength than panels made with conventional concrete;

with superior physical properties in terms of finish quality, porosity and mechanical strength;

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Develop new processes
Work locations:	Research Facility
Key Employees:	Frederic Tremblay (Beton Workshop) (History & Geography - BA (1990) / President of Beton)
Evidence types:	Samples, prototypes, scrap or other artefacts; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: As claimed = LOSS

f) to carry out this project, the appellant encountered technical uncertainties with respect to the choice of:

proportions of ingredients for concrete formulation;

chemical additives;

fiber types to achieve the desired surface finish and mechanical properties such as weight, porosity, compressive strength;

the method of making panels;

16] In order to achieve these objectives, the appellant had to overcome the following two major challenges:

a) develop a mixing and casting process so as to eliminate the formation of cracks and

b) determine chemical and physical parameters allowing to control the appearance of surface aggregates and to better control the color and the uniformity of the surface.

The most significant underlying key variables are:

ingredient proportions (unresolved), additives (unresolved), fibres types - weight, porosity, strength (unresolved), casting process (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Claimant arguments (Fiscal Year 2022)

Methods of experimentation:

(g) in an attempt to resolve the aforementioned technical uncertainties, the appellant used a trial and error (deduction) approach, involving the testing and experimentation of:

different concrete mix formulations by applying different types of chemical and fiber additives, such as nylon, metal, cardboard, glass sand, etc.;

a basic formulation using a new type of very thin fiber purchased in Japan;

different methods of preparations;

h) the work claimed by the Appellant also includes:

the making of a polymer mold for a hundred castings;

mold modifications;

addition of a standard cure sheet;

watering during the cure;

demoulding time

application of a release agent;

added sealant to prevent warping after 3 weeks;

thickness reduction to minimize internal stresses;

[17] During 2015, the Appellant carried out the following work, which is described in the CRA's SR&ED review report:

development of different concrete formulations by changing the percentage of ingredients;

development of a concrete recipe with few surface aggregates;

modification of the formulation by adding the additive which is the super plasticizer;

modification of the formulation by adding fly ash;

modification of the formulation by adding the shrinkage reducer;

design testing and concrete pour testing on a commercial site;

analyzes of results obtained in the laboratory and on a commercial site;

[18] While carrying out research activities, the appellant encountered the following technical problems, also described in the CRA's SR&ED review report:

the choice of the proportions of the ingredients for the formation of the concrete to obtain a polished surface, without cracking and of good color;

the choice of chemical additives;

the choice of casting method to obtain the desired results in terms of appearance and mechanical properties.

Results:

- Thickness: 0.5 inches (100% of goal)
- Strength: 100 % (100% of goal)

IN THE JUDGES VIEW:

(i) the Appellant has not identified or encountered any limitation of current technology and/or science in the development of concrete mixes and concrete panel manufacturing methods;

(j) the current state of science or technology, in the field of civil engineering, was sufficient to overcome the technical uncertainties encountered by the appellant;

(k) in its test log, the appellant made observations, for each of the tests, which do not demonstrate any measurement, hypothesis or analysis of a scientific or technological nature concerning, among other things:

warpage as a function of time;

the method of incorporating unknown compounds;

the relationship between the science or technology underlying the development of concrete panels and the unsatisfactory results of such testing;

Conclusion:

Documentation:

- Offline Documents: docs

Uncertainty #2: Documentation weaknesses

Technology or Knowledge Base Level:

Activity #2-1: Expert witness rebuttal (Fiscal Year 2022)

Methods of experimentation:

[25] More specifically regarding the modular panels project, Mr. Migneault (CRA expert witness) made the following comments:

the panel that the appellant is seeking to develop is a larger version than the one it already displayed in its available products (fibre-reinforced "concrete" panels measuring 2' x 4' and ½ or ¾ thick inches);

with the materials available, in particular at the level of adjuvants, the knowledge publicly available for the cure and the experience acquired by the appellant during the development of previous products, the appellant could obtain a panel with the targeted dimension of 4 x 8 feet with a thickness of ½ to ¾ inches;

at each stage of its work, the appellant proceeded by applying known solutions to resolve the technical problems encountered, without making assumptions aimed at addressing an uncertainty;

for lack of resources, the appellant did not examine the possible causes of failures;

the appellant did not produce statements concerning the flexural strength of its panels;

the series of tests aimed at determining the quantity of fibers are found in the experiment sheets without each test described being accompanied by quantitative measurements as to the effect of the addition of fibers in the cement formula; fiber types are also not identified in these tests;

the type of cement used for the tests is indicated in the readings but varies throughout the tests between three types and a combination of two of them without explanation of what is sought in these changes, with one exception;

the appellant did not seek to find the cause of the lack of durability of the moulds;

no quantitative measures are reported in the project description or in the experience sheets;

the methods of measuring the mechanical resistance (in compression and in bending) have not been identified and the values have not been reported;

for several tests, the formulation (quantity of cement, water and fibers) is not provided. In most cases, only the amount of cement (in terms of pockets) is indicated.

Results:

Conclusion:

Judge concluded:

[39] The analysis of the evidence reveals that the appellant did not adopt a scientific method in carrying out its research activities within the framework of its two projects.

Rather, the appellant proceeded to resolve its technical problems by trial and error methods without trying to understand or solve the problems associated with the technology used.

Project Name:	Beton - mixing and pouring concrete floors	Start Date:	2022-04-17
Project Number:	2222	Completion Date:	2022-11-23

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Compressive strength (mPa)	30	50	Yes

The following example is based on the Tax Court of Canada judgement BETON WORKSHOP INC., and HER MAJESTY THE QUEEN, Jan 27, 2022.

m) the objective of the project claimed by the appellant was to improve the process for mixing and pouring polished concrete floors in order to reduce the visibility of aggregates while:

respecting the compressive strength of 30-50 MPa;

eliminating the formation of cracks;

controlling the appearance of surface aggregates, surface color and uniformity, etc.;

Field of Science/Technology:

Civil Engineering (2.01.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Frederic Tremblay (Beton Workshop) (History & Geography - BA (1990) / President of Beton)
Evidence types:	Samples, prototypes, scrap or other artefacts; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: As Claimed = LOSS

n) the appellant encountered uncertainties of a technical nature in relation to the choice of:

proportions of ingredients for concrete formulation to obtain a polished surface, without cracking and of good color;

chemical additives;

the casting method to obtain the desired appearance and mechanical properties;

The most significant underlying key variables are:

additives (unresolved), casting methods (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Claimant arguments (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Trials:	10 runs / samples

o) in an attempt to resolve the aforementioned technical uncertainties, the appellant used a trial and error approach, involving, among other things:

the development of:

different concrete formulations by changing the percentage of ingredients;

a concrete recipe with few surface aggregates;

the modification by adding:

the additive which is the super plasticizer;

fly ash;

shrinkage reducer;

testing of different formulations and different casting processes in the laboratory;

concrete design and pour testing on a commercial site;

Results:

- Compressive strength: 50 mPa (100% of goal)

Conclusion:

Documentation:

- Offline Documents: docs

Uncertainty #2: Ideas per Expert witness

[26] Regarding the project for the mixing and pouring of polished concrete floors, Mr. Migneault made the following comments:

DEFINING KNOWN OR STANDARD INDUSTRY PRACTICES

concrete floors, even polished, do not represent a new product on the market. This area is also regulated. Public knowledge and the standards in force provided enough information to carry out the development of a manufacturing process or the improvement of this type of product;

from the starting formulation established by what is known in the field, the appellant then made educated guesses in order to achieve the desired characteristics for the product, polished concrete floors;

in order to increase the fluidity of the concrete, the appellant decided to add a super plasticizer. Super plasticizers have the property of making the concrete more fluid (plasticizing effect) and of increasing the strength of the concrete (compressive strength) thanks to the reduction of water that their use allows. The use of the product designed for this purpose gives the expected result and does not constitute an advancement;

in test # 7 , the fly ash was removed from the formulation and replaced with a shrinkage reducing agent, a product known to also reduce the formulation of cracks;

the cement mainly used (FA-56) seems to contain an air entrainer (foaming agent). The shrinkage-reducing agent will reduce this effect, but is not sufficient on its own, hence the use of a cure sheet. Therefore, the problems of cracks on the surface of the concrete and pores observed have been resolved with solutions known in the field and do not represent an advancement;

the type of super plasticizer used, naphthalene type, is a second generation plasticizer for concrete with an intermediate water reduction capacity.

Third-generation water reducers already existed back then. They provide superior water reduction while increasing the compressive strength of concrete. This type of concrete is called UHP (Ultra High Performance) concrete and is used today by the appellant.

The appellant increased knowledge base of products available on the market and of handling concrete.

The most significant underlying key variables are:

fibre types (unresolved), cement types (unresolved), water types and amounts (unresolved), setting times (unresolved), super plasiticers & foaming agents (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Suppliers	2 products	The expert witness clarified that third generation plasticizers already on market to solve problems cited

Activity #2-1: Expert witness critique (Fiscal Year 2022)

Methods of experimentation:

[26] Regarding the project for the mixing and pouring of polished concrete floors, Mr. Migneault made the following comments:

FACTORS INDICATING LACK OF SYSTEMATIC INVESTIGATION:

from the starting formulation established by what is known in the field, the appellant then made educated guesses in order to achieve the desired characteristics for the product, polished concrete floors;

the problems encountered were of a technical nature. Some have been resolved by solutions known in the field: the use of a shrinkage reducing agent and curing sheets for the reduction of surface cracks. Other solutions, such as adding fly ash causing unwanted staining, were simply circumvented or abandoned;

for this project, the type of client used is not indicated anywhere. Looking at the invoices, most of the cement purchased for the projects is a specialized type of cement for exterior structural repairs;

the type of water used during the tests is not indicated;

the bleeding observed during the first test can have several causes: too much water, poor handling after pouring, too long a setting time for cold weather. Only one cause has been explored: water reduction;

in tests no . 5 and no . 6, fly ash is added to reduce cracking. Invisible color develops as it dries. The appellant did not attempt to determine the cause of the problem and decided to simply remove the ingredient from the product formulation;

for the reproducibility tests carried out, experiment sheets are not provided and no results are reported;

the appellant acknowledges, for lack of resources, that all the possible causes of the failures were not examined;

Results:

As a result the expert proposed:

This is an apprenticeship that does not constitute an advancement;

the work was intended to support the appellant's learning in the manufacture of an existing product on the market, namely polished concrete floors;

although a register exists (experiment sheets), it does not contain hypotheses, nor all the measurements allowing to establish a relation of cause and effect in the parameters explored;

several important measurements, such as setting time, time between casting, measurement of surface hardness and concrete strength (compressive strength are not reported or are missing).

Conclusion:

Judge concluded:

[40] The appellant succeeded in developing modular concrete panels and polished concrete floors meeting the desired characteristics, but the appellant succeeded in doing so by using known technologies to solve the technical problems encountered. The comprehensive approach adopted was not aimed at achieving scientific or technological advancement.

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Power (hp)	425	500	Yes
Emission requirement (tier)	2	2	Yes
Power bulge (%)	5	8	Yes
Torsional coupler spike load capacity (x)	(not set)	(not set)	No
Price ($)	(not set)	(not set)	No

This project description is based on the Tax Court of Canada judgment of BUHLER VERSATILE INC., Appellant, and HIS MAJESTY THE KING, Respondent.Citation: 2023TCC18 Date: 20230206. paragraphs for source data have been [cited].

Introduction/Overview
[1] The appellant is an agricultural equipment manufacturer and specializes in the manufacture of agricultural tractors.

[2] The Minister of National Revenue disallowed the appellant's 2005 SR&ED claim for qualified expenditures totalling $3,591,220 with respect to seven projects.

[3] This hearing commenced in September 2019 and its in-person continuation was postponed three times due to risks/challenges presented by the COVID-19 global pandemic.

[5] The Minister says that the appellant's activities did not meet the definition of SR&ED and were more accurately described as routine testing, quality control, and/or product development.

[15] The appellant's fiscal year-end is September 30th and its 2005 SR&ED claim consisted of seven projects however,

[17] The bulk of the appellant's SR&ED claim is associated with project 5 (4WD Phase D Tier II High HP). During the hearing, both parties focused their respective presentations on this project.

[18] The appellant's goal in this project was to create a line of high-horsepower 4WD tractors which met Tier II emission standards and were suitable for agricultural and commercial construction (e.g. scraping/earth-moving/levelling) applications.

Within this line, they sought to build a 4WD tractor with over 500 horsepower, which would be above industry levels at the time. Mr. Janzen (Buhler, CFO) explained that more powerful agricultural tractors were needed as farms and farm implements had increased in size while the number of farm employees decreased.

Key Witnesses:
Appellant (Buhler)

Willy Janzen Chief Financial Officer
Barry Thompson Professional Engineer (Mechanical) since 1991
Allan Minaker Professional Engineer since 1982 Specializing in Power and Machinery
James Pell Mechanical Engineer with Cummins Inc. (Engine supplier)

Respondent (CRA) Research & Technology Advisor (RTA's)

Scott Lagadyn Professional Engineer since 2015,
Master of Science in Mechanical Engineering
Keith Chrystall Bachelor of Applied Science in Mechanical Engineering
Master of Science in Mechanical Engineering

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Name:	Buhler - Tractor design WIN	**Start Date:**	2023-01-01
Project Number:	2301	**Completion Date:**	2023-09-30

Project Details:

Intended Results:	Develop new processes, Develop new materials, devices, or products
Work locations:	Research Facility
Key Employees:	Alan Minaker (Buhler) (Machinery - BAsc. PEng. (1982) / Buhler Engineer)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Project planning documents; Design of experiments; Records of trial runs; Contracts

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

a) Torsional coupler:

[28] The appellant's 425-HP tractor used a version of the torsional coupler referred to as an LCD rubber coupler; Mr. Minaker described it as essentially a very large rubber ring in a metal shell and fairly commonly used in the tractor industry. To accommodate the larger QSX-15 engine, it was necessary to raise the engine which resulted in a 5-degree operating angle between the engine crankshaft and the transmission input shaft (which receives power from the engine). The LCD coupling ordinarily required the crankshaft and transmission input shaft to be in-line (i.e. at a 0-degree angle) so the 5-degree operating angle resulted in a whipping motion that greatly reduced the lifespan of the coupler.

(b) Cooling
[32] The larger QSX-15 engine presented the appellant with multiple challenges in terms of keeping it cool, thereby maintaining Tier II emissions compliance. Either a sufficient airflow must be created or a cooling system devised because insufficient cooling in turn negatively affects emissions. Mr. Minaker explained that a tractor typically operates in much dustier conditions than a highway truck. The dust and debris tend to plug the tractor's cooling system components and make it more difficult to keep the engine cool.

[33] As explained by Mr. Pell, an engine in a vehicle burns fuel to produce power but heat is produced as a by-product. A fast -moving highway vehicle will generate ground air which circulates through the radiator and a cooling stack, all of which serve to cool the engine and prevent overheating. On the other hand, the maximum speed of a tractor is significantly lower than that of a highway vehicle so its movement does not generate the same natural airflow for cooling.

The most significant underlying key variables are:

Cooling system design - dust & low airflow, torsional coupler - whipping,slip joint, materials, turbulent airflow vs. pressure effects, cooler face and shapes

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Competitive products or processes	4 products	No other competitor with 535 HP tractor. 4 main competitors worldwide with potential designs.
Similar prior in-house technologies	2 products / processes	rework of prior design concepts
Suppliers	1 products	Engineer from Engine supplier (Cummins Inc.) provided design input & expert witness
Queries to experts	1 responses	determining why the coupler failed, the appellant consulted with Torsion Control who in turn gave feedback and suggestions

Activity #1-1: Torsion coupler design (Fiscal Year 2023)

Methods of experimentation:

Method	Experimentation Performed

Analysis / simulation:	16 alternatives
Trials:	12 runs / samples
Physical prototypes:	4 samples

Torsional coupler
It started with spring couplers made by a company called Torsion Control, testing them both in the field and using a dynamometer (an engine-testing device which measures torque). Mr. Minaker explained that a torsional coupler should last over 5,000 hours but it was failing after less than 100 hours with the QSX-15 engine.

[26] Mr. Minaker described the torsional coupler as the connection between the engine and the rest of the powertrain.39 He explained that the QSX-15 engine ran at 2,100 rpm, which produces pressure pulses and exerts vibrational pressure on the crankshaft (which converts linear movement to rotational movement in an engine).

[27] He stated that the transmission (which controls the engine's power) would itself consist of multiple gears, shafts, and bearings rotating at various speeds. He explained that in this system of spinning components, a torsional coupler is needed to isolate and minimize vibration to prevent the vibrations from destroying the system itself. Mr. Lagadyn (CRA) described the purpose of the torsional coupler as that of forcing the power of the engine to go through it, thus providing its dampening effect to the rest of the drive line.

[29] The appellant decided to move away from a rubber coupling and try a spring coupler, i.e. which has no rubber and instead uses a series of springs for dampening. It started with spring couplers made by a company called Torsion Control, testing them both in the field and using a dynamometer (an engine-testing device which measures torque). Mr. Minaker explained that a torsional coupler should last over 5,000 hours but it was failing after less than 100 hours with the QSX-15 engine.

[30] In the process of determining why the coupler failed, the appellant consulted with Torsion Control who in turn gave feedback and suggestions. Mr. Lagadyn (CRA) succinctly summarized the appellant's approach as follows:

The appellant created a bench test apparatus. The apparatus, or test bed, featured a flywheel and a driveshaft operating at an angle. The intent of the test was to first fail the coupler and observe the baseline reliability, and then test improved coupler designs to measure the incremental reliability gained, if any. However, during bench testing, the appellant recognized that the testing was not matching the failures seen in the field. The appellant considered that the bench testing was creating steady state loads, whereas in the field the loads would be intermittent spike loads.

The appellant also considered the possibility that the coupling might be failing due to axial thrust loads on the coupler. The driveshaft contained a slip joint which would in theory prevent thrust loads. The appellant considered that high torque might be creating enough friction to prevent the slip joint from slipping as intended.

The appellant considered the thrust loading could be occurring on the coupler from relative movement between the engine and transmission (due to the engine and transmission shifting on their elastomer mounts). The appellant pursued the measurement of actual in-service loads and movements on the coupler and driveshaft on a full scale loaded tractor. The tractor driveshaft was outfitted with a strain gauge arrangement to measure the torque passing through the coupler and driveshaft.

Results:

[31] Mr. Minaker testified that the end design was one piece with 12 sets of springs (up from 9), which was larger and heavier but also more durable and more expensive.

Conclusion:

JUDGES RULING & RATIONALE:

[64] The appellant was focused and methodical in the way it uncovered, recognized, and resolved the issues involving cooling and the torsional coupler, as two examples of the larger challenges. It did not always know whether a specific theory would successfully resolve a particular issue but it always knew why it was testing that theory.

[65] For example, the appellant moved away from rubber couplers to spring-based ones because the rubber was breaking; however, the appellant did not know that the spring couplings would work. The appellant then eventually moved away from a 2-piece welded design to a one-piece design.

Significant variables addressed: torsional coupler - whipping,slip joint, materials

Documentation:

Offline Documents: docs

Activity #1-2: Cooling system design (Fiscal Year 2023)

Methods of experimentation:

[38] For maximum cooling, the appellant was challenged by the need to accommodate the physical size of the components while achieving proper fin-spacing; each component had protrusions called fins to increase their surface area for cooling.

Mr. Minaker explained that the tighter the fin-spacing, the better the heat rejection but the worse the airflow, and the appellant only had a limited amount of tractor face area to work with. He testified that it was important to keep the tractor at a reasonable size but they ultimately had to widen it twice in order to house the components.

[39] The appellant tested the cooling system using the dynamometer (called dyno testing) as well as doing field testing. Mr. Minaker stated that the dyno testing took place in a test cell which was a large enclosed room. The tractor would run at full throttle for 6 to 8 hours at a time and approximately 30 variables such as temperatures, pressures, and flows would be measured to determine how the cooling system was working.

[41] Another challenge involving the cooling system involved the charge air cooler itself. Mr. Minaker stated that Cummins had a very tight system specification called the intake manifold temperature differential (IMTD); it required that the air be cooled by at least 63 degrees Fahrenheit while the engine was operating at maximum horsepower.

The appellant changed the design of the charge air cooler to create a turbulent airflow which increased cooling but simultaneously reduced the air pressure inside the charge air cooler to an unacceptable level. Conversely, increasing the air pressure inside the charge air cooler led to an unacceptable IMTD.

The appellant ultimately increased the face area of the charge air cooler to compensate but in turn had to reduce the size of the oil coolers mounted underneath.

[42] Additional testing
The appellant put its tractors through a suite of other tests such as noise levels, steering, rollover protection system (called the cab test), braking, air conditioning, power train, manual transmission, bump track (involving random speed bumps),hydraulic system, and air seeder fans.

Results:

- Power: 500 hp (100% of goal)
- Emission requirement: 2 tier (100% of goal)
- Power bulge: 8 % (100% of goal)

[43] A limited number of these tractors went into production in late 2005. Mr. Janzen testified that at the time, this 4WD tractor was known to have the highest horsepower in the world. He stated that when its product life ended in 2014, the appellant sold the intellectual property associated with it for $2.6M in 2017.

Conclusion:

JUDGE'S RULING & RATIONALE:

[57] I am of the view that the technological uncertainty in this case fits squarely under the description of a system uncertainty. In other words, the integration of nontrivial combinations of established (well-known) technologies and principles carried a major element of technological uncertainty. When all the individual parts were combined, their individual uncertainties were merged into a system uncertainty and the system uncertainty was the entire tractor. All of the constituent parts needed to function in unison to achieve the appellant’s objective.

RULING ON COSTS:

[77] The 535-HP tractor was one of three models in that 4WD line and as indicated earlier, I consider the 435-HP and 485-HP models to lack the necessary system uncertainty to qualify for SR&ED absent specific evidence.

[78] As a principled basis, I would allow one-third of $2,916,197 as qualified SR&ED expenditures, i.e. $972,065.67 (rounded to $972,066) based on the 535-HP tractor being one of three models in the line.

Significant variables addressed: cooler face and shapes, Cooling system design - dust & low airflow, turbulent airflow vs. pressure effects

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Shelf life (days)	5	10	Yes
reduce salt (%)	(not set)	(not set)	No
increase protein (%)	(not set)	(not set)	No
maintain taste (%)	(not set)	(not set)	No
freeze / thaw credibility (%)	(not set)	(not set)	No
Cooking time (%)	100	80	Yes
Use of chemical preservatives (%)	30	0	Yes

This project description is based on the Tax Court of Canada judgment of CANAFRIC INC., Appellant, and HIS MAJESTY THE KING, Respondent. TCC 2023 108 Date: July 26, 2023

[1] This is an appeal by Canafric Inc. (“Canafric”) disallowing Scientific Research and Experimental Development (“SR&ED”) expenditures and the corresponding Investment Tax Credits (“ITCs”) for the 2013, 2014, 2015 and 2016 taxation years

[2] Canafric operates a food manufacturing business specialized in developing frozen pies mainly for the Canadian and the United States markets. During the Taxation Years, Canafric carried on various projects and activities aimed at developing new or advancing pre-existing products.

The 2013 SR&ED Claim included five projects, two of which, projects 1304 and 1306, were selected for a joint technical and financial review. These two projects were discussed at length during the September 14, 2015, on-site meeting.

Canafric’s customers outlined specific targets which included a higher shelf life without artificial preservatives, reducing salt and fat contents, increasing protein levels, maintaining product integrity during the freeze / thaw process. These targets were to be achieved without affecting the taste of the product. During his examination in chief, Mr. Zhou acknowledged that projects 1304 and 1306 posed a technological uncertainty.

[92] The 2014 SR&ED Claim included projects 1306, 1401 and 1402. Projects 1401 and 1402 were new products with specific requirements including salt and fat reduction, the replacement of potato flakes with “real potatoes”, using free from antibiotics meat, reducing cooking time.

[93] The 2015-2016 SR&ED Claim included seven projects, two of which, projects 1501 and 1502, were discussed during the March 8, 2018, meeting. The main challenges were to conceive a thicker filling, use a flaky pie crust that is compatible with all the fillings, reduce fat and salt contents, achieve a 21-day shelf life without any artificial preservatives and use halal products while preserving the taste profile of the products.
[

Field of Science/Technology:

Food and beverages (2.11.01)

Project Details:

Intended Results:	Develop new processes, Develop new materials, devices, or products
Work locations:	Research Facility
Key Employees:	Suvrut Pandya (Unknown - No technology background ? / CEO)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Samples, prototypes, scrap or other artefacts; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

PER THE JUDGE:

[94] Based on the challenges described by Mr. Pandya, projects 1304, 1306, 1401, 1402, 1501 and 1502 posed a technological uncertainty which could not be resolved by routine engineering or standard procedures. Canafric attempted to create recipes in order to meet client objectives for their products. Each project consisted of a new or improved product which meant there was no information available on how to achieve these goals.

A major source of disagreement for all SR&ED Claims was David Zhou's (CRA) position that each breakthrough was transferrable from one product to the other. For example, Mr. Zhou said that salt and fat reduction techniques could be replicated in different products.

Mr. Pandya clearly demonstrated that this was not the case because the ingredients will react differently when used in different products. Canafric was unable to achieve all of its targets.

The most significant underlying key variables are:

methods to reduce fat & salt, transferability of methods, cooking techniques to reduce time, effects of no anitbiotics on meats

Technology or Knowledge Base Level:

Activity #1-1: 2013 - 2/5 projects denied (Fiscal Year 2023)

Methods of experimentation:

2013 Taxation Year
[50] The 2013 SR&ED Claim was not completely denied. Some of the projects were accepted as filed. Only projects 1304 and 1306 were selected for a joint technical and financial review. Mr. Papadopoulos admitted that projects 1304 and 1306 had "some potential for SR&ED eligible activities" but they lacked the necessary supporting documentation accounting for the work performed.

[3] For the 2013 taxation year, Canafric claimed SR&ED in respect of five projects (the "2013 SR&ED Claim"):

i.1302: Mortimer's brand Saffron Garden
ii.1303: Loblaw's PC Scotch beef pie
iii. 1304: Metro Irresistible Asian Style dinners - X
iv.1306: Costco deli chicken pie fill - X
v.1307: Costco crustless quiche

[4] Projects 1304 and 1306 were selected for a joint technical and financial review by the Minister. By Notice of Reassessment dated May 13, 2016, the Minister disallowed SR&ED expenditures in the aggregate amount of $90,682 and corresponding ITCs in the aggregate amount of $22,183 in relation to these two projects.

2013 Taxation Year
[18] For the 2013 taxation year, the CRA reviewed projects 1304 and 1306.

(1) Project 1306
[19] Project 1306 was a pie filling developed for Costco, which was meant to follow a specific cooking process. Canafric would boil the filling to 165 degrees Fahrenheit to eliminate all bacteria. Canafric would then freeze the filling and pack it in 10 pound bags which were sent to Costco. Costco would make its own pies using the filling and bake it in the oven before displaying it in its refrigerator.

[20] In addition to the usual fat and salt reduction requirements, Costco wanted a pie filling that could achieve a 10-day shelf life including transportation time without using artificial or chemical preservatives. The challenges were to maintain product integrity and taste after three bakes, one freeze and two filling phases, achieve the targeted shelf life without artificial preservatives and increase protein levels in the filling by 35%.

[21] Canafric was unable to achieve a 10-day shelf life. Mr. Pandya testified that product samples were sent to an external laboratory for testing. The results established the product became unsafe for human consumption after six days. No plant trials took place for project 1306.

(2) Project 1304
[22] Mr. Pandya testified that "Metro Irresistibles Asian Style dinner" was not a new product. The customer simply wanted improvements to an existing product.

[23] Mr. Pandya described the main challenges as reducing salt and fat contents while preserving the taste profile of the items, maintaining the freeze / thaw credibility as well as maintaining shelf life without using artificial preservatives. According to Mr. Pandya, these improvements made the product “as good as new”.

Results:

- Shelf life: 6 days (20% of goal)
- Use of chemical preservatives: 20 % (33% of goal)

[25] Mr. Pandya testified that all the challenges relating to projects 1304 and 1306 were described to David Zhou during the meeting. David Zhou told Canafric’s representatives, including Mr. Pandya, that reducing fat and salt contents was not a technical challenge since salt and fat reduction techniques are transferrable from one product to another.

Conclusion:

Significant variables addressed: methods to reduce fat & salt, transferability of methods

Documentation:

- Offline Documents: docs

Activity #1-2: 2014 - 3/3 projects denied (Fiscal Year 2023)

Methods of experimentation:

For the 2014 taxation year, Canafric claimed SR&ED expenditures and ITCs in respect of the following three projects (the “2014 SR&ED Claim”):

i.1306: Costco deli chicken pie fill - X
ii.1401: Costco and Metro Irresistible Shepard’s Pies - X
iii. 1402: Loblaw’s Free from Chicken & Beef Pot Pies - X

[6] By Notice of Reassessment dated July 28, 2017, the Minister disallowed the entirety of the claimed SR&ED expenditures and corresponding ITCs in relation to Project 1306, Project 1401 and Project 1402.

2014 Taxation Year
[29] For the 2014 taxation year, the CRA reviewed projects 1306, 1401 and 1402.
[30] Mr. Pandya explained that Project 1306 ran into the 2014 taxation year because of the potentially lucrative contract it could have led to if Canafric could overcome the challenges.

(1) Project 1401
[31] In project 1401, the main challenges were to replace potato flakes with “real potatoes”, use leaner beef (from 75% muscle and 25% fat to 85% muscle and 15% fat) as well as the usual fat and salt reduction. Project 1401 was successful.

(2) Project 1402
[32] Regarding project 1402, he described the main challenges as using “free from antibiotics” animals and reducing cooking time by 20 to 50%.

Mr. Pandya explained that the elimination of antibiotics created challenges with the “quality of the protein”. Since each animal has different immunity levels, chickens and whole cattle beef differed in quality and in texture. As for the cooking time, it led to microbiology concerns since it was not sufficient to reach the usual 165 degrees Fahrenheit, which ensures elimination of bacteria.

Results:

- Cooking time: 85 % (75% of goal)

Conclusion:

Significant variables addressed: cooking techniques to reduce time, effects of no anitbiotics on meats

Activity #1-3: 2015 - 3/7 projects denied (Fiscal Year 2023)

Methods of experimentation:

[7] For the 2015 taxation year, Canafric claimed SR&ED expenditures and ITCs in respect of the following seven projects (the “2015 SR&ED Claim”):

i.1303: Loblaw’s PC Scotch beef pie

ii.1307: Costco crustless quiche.
iii. 1401: Costco and Metro Irresistible Shepard's Pies - X
iv.1501: Mortimer's Hand Held Pies "On the Go" - X
v.1502: Mortimer's Halal Kitchen Frozen Entrée - X
vi.1503: National Foods Frozen Dinner Entrée
vii. 1504: Swiss Chalet & Cara Foods Frozen Entrée

[8] By Notice of Reassessment dated August 9, 2019, the Minister disallowed SR&ED expenditures totalling $97,895 and the corresponding ITCs totalling $15,476 in relation to projects 1401, 1501 and 1502.

The Minister conducted a joint review for the 2015 and 2016 SR&ED Claims.
(1) Project 1501

[34] Project 1501 aimed to develop twelve pocket-sized frozen pies that could be safely consumed after being heated in a microwave or an oven.

[35] The main challenges were to conceive a thicker filling, use a flaky pie crust that is compatible with all the fillings, reduce fat and salt contents and achieve a 21-day shelf life without any artificial preservatives.

[36] Mr. Pandya also outlined the challenges relating to the packaging of the product. He explained that Canafric had to use paper coated with chemicals to ensure the product could be microwaved in a minute. The lamination inside the paper allowed the microwave heat to be transferred 100 times faster than it would have been with normal paper.

[37] Mr. Pandya explained that project 1501 was not successful because the product was not firm enough to be hand-held. This was mainly due to the filling leaking moisture into the pastry. Canafric was also unable to achieve the required shelf life.

(2) Project 1502
[38] Project 1502 involved the development of a series of halal products. In cross-examination, Mr. Pandya admitted that this was not their first experience with halal products since Project 1501 also involved some halal products. Mr. Pandya explained that the halal requirement created challenges regarding the raw materials which had to be halal-based and the shortenings which could not be animal based.

Results:

CRA POSITION:

[41] The challenges were described to David Zhou during a March 8, 2018, on-site meeting that took place regarding the 2015-2016 SR&ED claims. Mr. Pandya testified that the meeting was originally meant to review two projects (1501 and 1502), but David Zhou chose to focus on project 1501.

[42] During the meeting, David Zhou took the position that only the first product in project 1501 (the butter chicken) created a technical challenge because he was of the view that Canafric could apply the knowledge it gained during the product development for that product to overcome the similar challenges it encountered for the eleven other products.

Conclusion:

Activity #1-4: 2016 - 3/6 projects denied (Fiscal Year 2023)

Methods of experimentation:

For the 2016 taxation year, Canafric claimed SR&ED expenditures and ITCs in respect of the following six projects (the "2016 SR&ED Claim"):

i.1501: Mortimer's Hand Held Pies "On the Go" - X
ii.1502: Mortimer's Halal Kitchen Frozen Entrée - X
iii. 1503: National Foods Frozen Dinner Entrée
iv.1504: Swiss Chalet & Cara Foods Frozen Entrée
v.1601: Alimentation Couche-tard Chilled Pies
vi.1602: Longo's Savoury Pies - X

[10] By Notice of Reassessment dated August 9, 2019The Minister disallowed SR&ED expenditures totalling $154,872 and the corresponding ITCs totalling $23,304 in relation to projects 1501, 1502 and 1602.

(3) Project 1602
[39] Project 1602 aimed to develop nine meat and vegetable pies for Longo's. The customer specified the pastry should not contain lard. At least 10% of the shortening had to be made of real butter. The customer also wanted the pies to come in two sizes, which meant Canafric had to elaborate a different heating process for each pie. Salt and fat content reduction was not

a requirement for this project.

[40] Mr. Pandya testified that David Zhou rejected the claim regarding project 1602 saying, “a pie is a pie what is the big deal about it”.

Results:

Conclusion:

Activity #1-5: Judges ruling and rationale (Fiscal Year 2023)

Methods of experimentation:

Results:

JUDGE'S RULING & RATIONALE: 5 criteria per NW Hydraulics case:

I) TECHNOLOGICAL UNCERTAINTY
[87] The first criteria, whether there is a technological risk or uncertainty, stems from the words of paragraph 248(1) ITA, namely the requirement for a technological advancement. A technological advancement is needed when it is unknown or uncertain whether a certain objective can be accomplished, due to a lack of scientific knowledge.

II) HYPOTHESIS
[102] Mr. Pandya described Canafric’s development process as follows:
i.The client requests a product with specific features.
ii.Canafric elaborates a recipe designed to meet the client’s requirements.
iii.The recipe is tested to ensure it meets the requirements.
iv.The product is sent to a “taste panel” to evaluate its taste.

[104] This process meets the second criterion. Canafric formulated hypothesis specifically aimed at achieving its various goals.

III) SCIENTIFIC METHOD
As for the third criterion, whether the process accorded with the scientific method, the CRA’s position was that Canafric relied on a “trial and error” approach by trying various recipes to reach its targets and without attempting to explain or analyze the reason why each recipe did not work.

I disagree with this position. When it found a recipe could not meet client requirements, Canafric’s main takeaway was not simply that it did not work. Canafric conducted analyses in order to understand which requirement was not met and modified specific parts of the recipe in order to address the issue. In doing so, Canafric was limited by its clients’ demands regarding which ingredients to use.

IV) TECHNOLOGICAL ADVANCEMENT [NOT CITED IN JUDGEMENT]

V) RECORDS & NATURE OF SUPPORTING DOICUMENTATION

[105] The fifth criterion, whether the claimant kept a detailed record of the hypotheses tested and results as the work progressed

[110] Documentary evidence is not mandatory. Testimonial evidence may be presented in support of a claim. In this case, Canafric provided both documentary and testimonial evidence in support of its various claims.

[111] On September 14, 2015, an on-site meeting took place regarding the 2013 SR&ED Claim and specifically projects 1304 and 1306. Mr. Pandya testified that all the technical information regarding these projects was explained orally to Mr. Zhou during the meeting. This was corroborated by Mr. Zhou himself.

Mr. Papadopoulos and Mrs. Hassanein, while they could not speak to the specifics of the discussion, confirmed that a “lengthy technical discussion” took place between Canafric’s representatives and Mr. Zhou.

Conclusion:

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Efficiency (%)	80	90	No

This project description is based on the Tax Court of Canada judgment of ACBK Management Inc. vs. The king Date : 2022-09-29, Neutral reference : 2022 CCI 94, File number : 2015-3974(IT)G

8] André Roy (“Mr. Roy”) was the president and sole director of Hydro LMR during the relevant period. He is an electromechanical by training and specializes in automation/. mr. Roy's work consisted mainly of designing, installing and programming automated systems in the food industry.

9] On an unspecified date before the year in question, Dominic Laperle (“Mr. Laperle”) had installed a system called

“hydrodynamic system for the energy-efficient assistance of a building, construction methods and corresponding uses" in a residence in Saint-Césaire, in the province of Quebec. Mr. Laperle obtained a patent for this system.

According to Mr. Roy's testimony, Mr. Laperle's system makes it possible to reduce the effect of a building on the environment by making it self-sufficient in energy.

[10] After the construction of the residence was completed and the hydrodynamic system was installed, Marc Brunet (“Mr. Brunet”), of the Center de recherche industrielle du Québec (“CRIQ”), contacted Mr. Roy to to ask him if he could improve Mr. Laperle's system. To this end, Mr. Brunet asked him to accompany him on a visit to the residence in Saint Césaire.

Following the visit, Mr. Roy became interested in Mr. Laperle's system and decided, through Hydro LMR, to purchase land in Saint Alphonse de Granby, in the province of Quebec, to build a triplex and install an improved version of Mr. Lapierre's system.

[11] To this end, Hydro LMR created a project called "Study and Analysis of a Thermal Storage System"

Field of Science/Technology:

Applied mechanics (2.03.02)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility, Research Facility
Key Employees:	Andre Roy (ACBK) (Unknown - TECHNICAL BACKGROUND NOT DISCLOSED (2000) / Presdient)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Project planning documents; Photographs and videos; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[28] According to Mr. Roy, in order to design his “life-size” prototype, he used Mr. Laperle's notes and patent. However, he identified a major design problem in Mr. Laperle's system. According to him, the temperature of the water in the tanks was not adequate; it was way too cold and freezing.

This prevented the pump that was used to transport water to the solar panels installed on the roof of the building from working properly. Still according to Mr. Roy, the causes of the problem were the size of the tanks, the absence of a probe to measure the temperature and the programming of the control panel.

[29] Mr. Roy testified that when designing his system, he faced two technological uncertainties, namely the size of the water tanks and the temperature of the water they contained.

The most significant underlying key variables are:

tank size (unresolved), water temperatures (unresolved), basin orientations (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Patent searches	1 patents	work aims to improve on existing patented process

Activity #1-1: Activity 1 (Fiscal Year 2023)

Methods of experimentation:

Method	Experimentation Performed
Trials:	1 runs / samples
Physical prototypes:	1 samples

[26] In this case, in order to be able to install an improved version of Mr. Laperle's hydrodynamic system on the triplex, Mr. Roy first purchased Mr. Laperle's patent for the system. He also used Mr. Laperle's handwritten notes to design and install this second prototype of the triplex hydrodynamic system.

Before construction of the triplex began, Mr. Roy met with Daniel Rousse (“Mr. Rousse”), researcher holding the Industrial Research Chair in Energy and Efficiency at the École de technologie supérieure (“ÉTS”), to to carry out a numerical simulation of its system. After this meeting, Mr. Roy obtained the ÉTS report with the results of the simulation. Subsequently, Mr. Roy decided to build a “life-size” prototype of his system, which he integrated into the triplex.

[27] The system designed by Mr. Roy included, among other things, solar panels installed on the roof of the building, concrete water tanks filled with gravel buried under the concrete floor of the basement of the building, a heat pump , a radiant floor system, a control panel (computer) and probes to measure the water temperature in the tanks.

[29] Mr. Roy testified that when designing his system, he faced two technological uncertainties, namely the size of the water tanks and the temperature of the water they contained.

In order to solve these problems, with the help of the data contained in the ÉTS report, Mr. Roy changed the size of the pools and installed probes to measure the temperature as well as additional valves. He therefore changed the size of the basins used by Mr. Laperle, in addition to inserting the smaller of the two basins inside the larger one.

In addition, he installed a third basin (a conventional water heater) outside the building and connected it to the system. Finally, he also installed and programmed the control panel which also controls the water pump.

According to Mr. Roy, these uncertainties could not be eliminated using standard procedures or standard techniques.

Results:

CRA arguments:

[31] In addition, according to Mr. Desmarais' testimony, Mr. Roy used known thermodynamic principles to measure energy exchanges in a system. Still according to Mr. Desmarais, it was possible to measure the heat exchanges between the basins and to model the system envisaged by using equations and mathematical concepts known at the time in order to estimate the adequate dimensions of the basins. A scale model could also have been used to test it.

[32] Finally, Mr. Desmarais also indicated that Mr. Laperle's patent referred to other prior patents relating to thermal storage, which enabled him to conclude that there were systems similar to the one designed by Hydro LMR since the 1980s.

Conclusion:

JUDGES RULING & RATIONALE:

[30] The evidence shows that Mr. Roy used standard techniques to try to resolve the two technological uncertainties he was facing. During his testimony, Mr. Roy did not describe precisely the techniques he used to
try to overcome these uncertainties, whether during the design or the construction of his system.

The evidence does not show that the modification of the sizes of the pools, the installation of probes for measuring the temperature, the installation of valves and the design and installation of the control panel required the use of practices which were not not commonly used at the time.

[33] The appellant has not demonstrated that the technological uncertainties faced by Hydro LMR during the design and installation of its hydrodynamic system could not be eliminated by current techniques or by usual procedures.

The Court concludes that Mr. Roy used standard techniques to try to resolve the two uncertainties he faced.

[34] Consequently, the Court concluded that the activities ... do not constitute SR&ED activities within the meaning of the ITA.

AUTHORS NOTE - POTENTIAL STEPS ON HOW TO TURN THIS JUDGEMENT INTO A WIN

- Get expert opinions or testimony - e.g. testimony from Marc Brunet (“Mr. Brunet”), of the Center de recherche industrielle du Québec (“CRIQ”), who had contacted Mr. Roy to to ask him if he could improve Mr. Laperle's system.

- perform more detailed prior art review - for example review of initial patent & correlation of current analysis to issues cited

Documentation:

Offline Documents: docs

Project Name:	Mold Leaders Mold designs LOSS	Start Date:	2023-04-01
Project Number:	2304	Completion Date:	2023-10-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
units before misalignment (cycles)	200	10000	No
Hardness (hrc)	40	55	No

This project description is based on the Tax Court of Canada judgment of MOLD LEADERS INC., Appellant, and HIS MAJESTY THE KING, Respondent Citation: 2023 TCC 127, Date: August 21, 2023, Docket: 2019-3354(IT)G

[9] Mr. David Duong was the primary witness for the appellant, ML. He is ML's owner and president. I found him knowledgeable and credible. He testified in English - his fourth language. Following high school, he graduated from a two-year mechanical technician program at Humber College in Toronto. He there learned CAD/CAM design and CNC machining.

[10] CAD/CAM means computer-aided design and computer-aided manufacturing. CNC means computer numerical control machining. Mr. Duong worked for five years with a company that introduced him to mold making, and where he became head of the CNC machining department.

[11] He moved from there to a newly established company that grew quickly in the business of mold making. In turn, in 2002 this prompted Mr. Duong to start his own mold maker company, being the appellant, ML.

[52] ML called one other witness, being Mr. Amit Saini. He is a professional engineer and certified professional accountant. Also, he is president of National R&D Inc. (National R&D). Neither he nor National R&D had any involvement with the subject projects while being worked on by ML.

The Eight Projects:

ML spent much time in high- precision machining in the making of molds and related items. In the relevant years of 2016 and 2017, ML engaged in approximately 320 projects brought to it by customers. The projects were not carried on with SRED in mind. But, subsequently eight of these projects were claimed for SRED and are at issue in this appeal.

For illustrative purposes we will examine the first of the 8 projects then summarize the basis for judges denial of the claim.

Project 1: this project commenced with a 2016 contract ML had with a customer, Dynaplas, for ML to design and make a 4-cavity mold for production of a particular valve for use in anti-lock braking systems in the automotive industry.

[16] The mold was to open and eject the part once solidified. Initially H13 steel was used for making the mold. The part was plastic but hardened with 30 percent glass, which made the plastic harder than ML was used to. The first mold made with H13 steel was not acceptable. The customer's testing of the mold revealed that it misaligned after a short period. After further work ML and Dynaplas agreed that W360 steel be used, having a higher hardness rating than H13 steel. ML did not itself have experience with W360 steel. ML obtained the W360 steel from a European company.

Field of Science/Technology:

Materials engineering & metallurgy (2.05.01)

Project Details:

Intended Results:	Develop new processes
Work locations:	Commercial Facility
Key Employees:	David Duong (Mold Leaders) (CNC machining - mechanical technician (2000) / President)

Project Name:	Mold Leaders Mold designs LOSS	**Start Date:**	2023-04-01
Project Number:	2304	**Completion Date:**	2023-10-31

Evidence types: Design of experiments; Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Photographs and videos; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[17] ML had to learn to work with W360 steel, with which it was unfamiliar. W360 steel was harder to cut and grind, i.e. mill. Ultimately, eight versions of the mold were tested by the customer (not ML) and sent back to ML six times with comments for improvement. Ultimately, a mold was accepted.

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	1 Articles	examples of key issues in machining hard metals

Activity #1-1: Activity 1 (Fiscal Year 2023)

Methods of experimentation:

Method	Experimentation Performed
Physical prototypes:	8 samples

[18] ML's counsel, in his direct examination of Mr. Duong, asked him what ML achieved "in terms of technology" through its work on this project:

Q: But in terms of technology, what did you advance? What did you achieve, what did you advance? [underlining added]

A: So we learned that the hard milling processing is like - - it's just like a science, you put too many - - so many things together then you can achieve it.

Q: Okay. But at the beginning you said you had - - you know, you would be able to go and give it a shot. But how - - what did you anticipate the problems being versus what the problems were? Was it - - how relatively - - how hard was it relative to what you anticipated?

A: We did not expect that we were going though [sic] these issues. It was some kind of - - something is just pulling you, that caught us off guard. But it's the way that we wanted to - - we don't want to keep doing those projects that we are not going anywhere.

So we like to delegate certain jobs that we should take challenges or take a new approach to bring out our experience, so to compete in this (inaudible). So we learned in a hard way, yes, that's what - - have to say that [sic].

Q: You learned the hard way?

A: Yeah.

Results:

The judge noted:

[19] In answering what was achieved, Mr. Duong did not identify a technological advance. Of note also is ML counsel's reference to the ML work as, "all this trial and error".

[54] I note also that as its first witness in this matter ML called an individual seeking his acceptance as an expert witness knowledgeable of the plastic injection molding industry.

A voir dire was conducted on the first day of the hearing into whether he could be accepted as an expert. I rendered an oral decision finding based on the voir dire that the individual did not have sufficient background in the plastic injection molding industry to be qualified as an expert in that industry.

Accordingly, he was not accepted as an expert and his expert report was not admitted into evidence.

Conclusion:

RULING & RATIONALE: LOSS

The judge commented;

[59] Here there was not evidence as to the overall industry state of knowledge in the context of any of the eight projects.

[60] It is pleaded “the Appellant did not identify or encounter any technological uncertainty which could not be removed by the Appellant’s knowledge base”. This assumption was not disproven.

The fact that no evidence was called as to the state of knowledge in the mold making industry generally made it difficult to know if and when a “challenge” for ML did or did not constitute a technological risk or uncertainty.

[61] The above extracts from Mr. Duong’s testimony for the eight projects generally reflect that ML’s success or advancement as to those projects involved a routine engineering and standard practices approach, using methodology familiar to ML.

When he was asked by ML’s counsel for each project what had been achieved or learned, the answers did not reveal or identify technological uncertainties being addressed in a scientific manner.

This is not compatible with technological risk or uncertainty intended in a SRED context. Routine engineering and standard practices includes a trial and error approach, although not a scientific approach of forming and testing hypotheses.

[68] The appeal will be dismissed, with costs. ML did not establish that four of the five requirements for establishing SRED for each of the eight projects were met.

Documentation:

- Uploaded to RDBASE.NET: MachinabilityFactors-wp.pdf (385KB)
- Offline Documents: docs

Project Name:	Daves Diesel - injector process LOSS	**Start Date:**	2023-05-31
Project Number:	2305	**Completion Date:**	0001-01-01

Project Details:

Scientific or Technological Objectives:

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Develop new processes
Work locations:	Commercial Facility
Key Employees:	
Evidence types:	

Project Name:	Daves Diesel - injector design LOSS	**Start Date:**	2023-05-04
Project Number:	2305	**Completion Date:**	2023-10-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
remanufacture injectors (number)	0	3	No

This project description is based on the Tax Court of Canada judgment of Dave's Diesel Inc. v. The Queen Date 2022-06-10
Neutral citation 2022 TCC 62 File number 2018-1618(IT)G

The Nature of the Project
[6] The Appellant called Mr. Rushi Dave as its only witness. Mr. Dave was General Manager of the Appellant in 2013 and 2014. He was one of four individuals who worked on the project.

[7] Mr. Dave did not study mechanical engineering and has no degree, certificate or designation in the field. However, he did study business and marketing and worked for a large advertising, marketing, and public relations firm before joining the Appellant 15 years ago.

[8] Mr. Dave’s father established the Appellant’s business in Brampton, Ontario a decade before starting the project. Although Mr. Dave described the Appellant as a fuel injection shop for the diesel engine industry, it was not a mechanic shop as no mechanics worked there.

[9] Before starting the project, the Appellant remanufactured components of used mechanical fuel injection systems for dealers under warranty programs offered by the manufacturers of the injectors. The Appellant went about remanufacturing components of used mechanical fuel injectors in the following way:

The process was to receive the component from an engine shop, like the dealership, then we would disassemble it, do an assessment of its failures, and then reassemble it with brand new components, and put it on a test stand to recalibrate [it] to [the] provided manufacturer specifications. [3]

[10] By 2007 or 2008, electronic fuel injection systems began to replace mechanical fuel injection systems in diesel engines. The Appellant found itself in difficulty as manufacturers would no longer pay the Appellant to remanufacture components of their used fuel injection systems. Presumably, they wanted their customers to purchase new units as replacements. In any event, the Appellant needed a new source of income.

[11] The Appellant, therefore, set out to find a way to remanufacture injectors on its own. Those injectors were found in diesel-powered trucks, generators, marine equipment, and construction and farm equipment. The Appellant studied three types of injectors as part of the project:

(a) Delphi 4 Pin (an electronic fuel injector used in certain Volvo diesel engines);

(b) C7 (an electronic fuel injector used in certain Caterpillar diesel engines); and

(c) ISX (a mechanical fuel injector used in certain Cummins diesel engines).

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Develop new processes
Work locations:	Commercial Facility
Key Employees:	
Evidence types:	Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Photographs and videos; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[26] The Appellant says that the relevant “technological uncertainty” was whether it could successfully develop a process to remanufacture the three different types of injectors. [11]

The most significant underlying key variables are:

shim thickness (unresolved), spring pressure (unresolved)

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2023)

Methods of experimentation:

Method	Experimentation Performed
Trials:	22 runs / samples
Physical prototypes:	3 samples

21] Most of the diary entries are rather concise. The following are some of the more descriptive ones (square brackets indicate the type of injector tested):

January 4, 2013

Broke [Delphi 4 Pin] injector trying to understand how it comes apart.

January 23, 2013

Purchased and tested 12 [C7] cores and found all to be operating differently and having leaks from different sections of injector.

February 25, 2013

Received prototype [C7 adapter] from machine shop and installed. The thinner O ring would not stand up to the pressure and kept breaking.

March 6, 2013

Continued [ISX] trials and documenting results. Not ideal and still not operating as expected. No atomization.

March 15, 2013

Used a thin steel punch and applied pressure from the top of the [Delphi 4 Pin] injector and popped out the terminal insulating sleeve and seal.

....

September 12, 2013

Run [Delphi 4 Pin] trials with different shim thicknesses.

September 25, 2013

Spring pressure trials [Delphi 4 Pin].

[22] The Appellant also produced a partial record of a single test performed on a C7 injector in 2013 (Exhibit A-2 reproduced at Appendix “A”) and a partial record of a single test performed on the same type of injector in 2014 (Exhibit A 1 reproduced at Appendix “B”).

[23] As Mr. Dave presented his oral evidence, he showed the Court a series of colour photographs illustrating the machines and tools used in the project.

Was a detailed record of the hypotheses, tests, and results kept as the work progressed?
[43] The Appellant has not satisfied its onus to demonstrate that it recorded, in respect of any particular test performed in 2013 and 2014:

(a) the formulation of a hypothesis;

(b) the testing of that hypothesis; and

(c) the modification of that hypothesis in light of the results of the test.

[44] Take the shim thickness test of September 12, 2013 or the spring pressure test of September 25, 2013 as examples.

What shim thicknesses were tested? What were the results of each test? Which shim thicknesses passed the test?

What was the standard selected for passing the test?

For the spring pressure test, what pressures were applied and for how long? What were the results of each test at each pressure and for each duration? At what pressure, and at what point, did each spring fail?

There is no record of the answers to these questions.

Results:

1. Was there a technological risk or uncertainty that could not be removed by routine engineering or standard procedures? The phrase “routine engineering” describes techniques, procedures and data that are generally accessible to competent professionals in the field.

[27] The fact that a small group of non-engineers and non-mechanics, including two unskilled labourers, did not know whether they could remanufacture three types of used fuel injectors tells us nothing about whether it was “technologically uncertain” that those fuel used injectors could have been remanufactured by a competent professional in the field.

[36] An example will illustrate the point. Here is the diary entry for February 25, 2013:

February 25, 2013

Received prototype [C7 adapter] from machine shop and installed. The thinner O ring would not stand up to the pressure and kept breaking.

[37] The hypothesis to be tested might have been: “An O-ring 5 mm. thick should withstand pressure of 50 lb/ft. as effectively as an O-ring 7.5 mm. thick”. That hypothesis would have been the subject of the test. The results of the test would have been recorded and analyzed and modifications made to the hypothesis in light of the test results.

[38] As Justice Sommerfeldt has noted, a hypothesis is “a statement to be tested by an experiment or a trial.” [16]

[39] In respect of any particular test performed in 2013 or 2014, the Appellant has failed to show:

(a) the formulation of a hypothesis (e.g., in respect of the O-ring on February 25, 2013, or the shim thickness on September 12, 2013, or the spring pressure on September 25, 2013, etc.);

(b) the testing of that hypothesis; and

(c) the modification of the hypothesis in light of the results of that test.

Conclusion:

[29] The onus was on the Appellant to demonstrate that it was “technologically uncertain” that the used fuel injectors could have been remanufactured by a competent professional in the field – a mechanical engineer, for example. [13]

[30] But even if I had found the requisite “technological uncertainty”, I would still have no basis on which to decide whether

the steps taken by the Appellant were anything other than “routine engineering” for a competent professional in the field.

There was no evidence that taking a fuel injector apart without breaking it was anything other than “routine engineering” for such a professional. Similarly, there was no evidence that understanding how the fuel injectors worked was anything but “standard procedure” for a competent professional in the field.

Documentation:

- Offline Documents: docs

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Sensors (per gun vs per cell) (number)	1	12	No

This project description is based on the Tax Court of Canada judgment of JEC Distributors Inc. v. The King Date 2022-12-28 Neutral citation 2022 TCC 170 File number 2019-1422(IT)I

[1] The Appellant is a manufacturer and distributor of products for the auto industry. It primarily focuses on welding products and technology. The Appellant is what is known as a Tier 2 manufacturer.

[2] When the Appellant filed its tax return for its taxation year ending September 30, 2016, it claimed scientific research and experimental development expenditures of $91,537 in respect of three different projects. The Minister of National Revenue denied that claim and the Appellant has appealed.

Testimony
[3] Three of the Appellant's employees testified: Joe Ruggiero, Paul Lichaa, and Bill Dodge. I found each of them to be credible witnesses. They provided very helpful descriptions of the Appellant's work and the work involved in the projects in question.

[4] I also heard the testimony and cross-examination of Jason Sousa from the Canada Revenue Agency. I found him to be a credible witness but his evidence was of little assistance to me.

[8] There are three projects in issue. Each of them relates to the Appellant's resistance welding products.

We will analyze the first of these projects:

C. Project 1
[9] The first project was called the "Data Link Flow Monitor". The Appellant's witnesses explained that the Appellant's welding guns have two welding tips that close over the metal to be welded like a jaw.

[10] During the welding process, the tips become very hot. Water is run through the guns to help cool the tips. It is important that the water is the appropriate temperature and that it flows at an appropriate rate. If the water becomes too warm or stops flowing properly, the welds will not work properly or the tips will fuse to the metal they are welding and be pulled off the guns. In either case, the Appellant's customers will have to shut down their manufacturing lines which will cost the customers time and money.

[11] The purpose of Project 1 was to develop a system of sensors that could be applied to each welding gun to monitor the flow and temperature of the water to that gun.

[12] A welding cell is an area on a manufacturing line containing one or more welding guns. Existing temperature and flow systems measured the water flowing to the entire welding cell. The Appellant believed that a system that monitored each gun individually would allow its customers to pinpoint which gun in the welding cell was causing a problem and thus reduce the amount of shut down time.

Field of Science/Technology:

Materials engineering & metallurgy (2.05.01)

Project Details:

Intended Results: Develop new processes

Project Name:	JEC Distributors - welding LOSS	**Start Date:**	2023-06-01
Project Number:	2306	**Completion Date:**	2023-11-30

Work locations:	Commercial Facility, Research Facility
Key Employees:	
Evidence types:	Records of resources allocated to the project, time sheets; Samples, prototypes, scrap or other artefacts; Contracts

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[13] To gather data from each gun, the Appellant also needed to find a way to connect each welding gun's temperature and flow monitors to the customers' manufacturing computer systems, preferably using Ethernet connections. This presented challenges because different customers operated different systems.

[14] Finally, the Appellant believed that, if it could gather enough data from the welding guns, it could develop algorithms that would help to predict when a problem was going to arise. This would allow the Appellant's customers to anticipate problems and possibly fix them before they happened.

The most significant underlying key variables are:

electrical noise mitigation (unresolved), communication protocols (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Suppliers	1 products	approached supplier of flow monitoring methods

Activity #1-1: Activity 1 (Fiscal Year 2023)

Methods of experimentation:

[15] The witnesses explained that the Appellant tested a number of different sensors to monitor flow and temperature. It kept changing the technologies until it found something that it thought would work not only in the lab but also on the manufacturing line.

[16] After encountering problems with standard flow monitoring technology, the Appellant asked a company with expertise in flow monitoring to develop a custom solution for them. However, it had problems connecting those monitors to the customer's systems because it could not get access to the relevant proprietary software.

Results:

[17] Ultimately, the biggest problem for the Appellant was that there was a lot of electrical noise on the manufacturing line and it interfered with the sensors. This electrical noise is well known to be an issue with resistance welding.

[18] The Appellant also found that the sensors could not withstand the dirt and contamination present in a welding cell.

Finally, there were challenges with communication protocols. The Appellant had problems finding a way of sending so many different signals to and from the welding cell at the same time without slowing down the other communications that need to happen on the line.

[19] To date the Appellant has been unable to overcome any of the above problems

Conclusion:

22] However, it is not enough for the Appellant to prove that it could not remove the risks and uncertainties through routine engineering or standard procedures. The test is an objective test, not a subjective test. The Appellant must show that the risks could not be overcome by routine engineering or standard procedures generally accessible to competent professionals in the field. The Appellant did not do so.

[23] The Appellant's expertise is in welding technology. I have no way of knowing, for example, whether an electrical engineer or even a skilled electrician could have proposed a routine solution to prevent the electric noise from reaching the sensors. Similarly, I have no way of knowing whether a computer engineer or a technician with networking expertise could have employed standard networking procedures to connect the sensors to the Appellant's customers' networks.

[24] Based on all of the foregoing, I find that Project 1 does not meet the first test.

[25] I note that, as the Appellant never proceeded to the stage of attempting to develop algorithms, I have not considered whether that part of Project 1 would have met the first test.

Documentation:

Offline Documents: docs

Project Name:	New AI examples from USPTO	**Start Date:**	2024-01-01
Project Number:	2400	**Completion Date:**	2024-12-31

Project Details:

Scientific or Technological Objectives:

The following examples were released during 2024 by the USPTO guidance and training materials on issues relevant to the use of Artificial Intelligence (AI).

https://www.uspto.gov/initiatives/artificial-intelligence/artificial-intelligence-resources

The following examples are reproduced from the original USPTO documents and are intended to be illustrative of claim construcion and analysis for tax credtist, grants or patent eligibility issues. As a result some of the USPTO references have been included (E.G. Step 2A, Prong Two) for user reference.

The first 2 projects address "Subject Matter Eligibility" issues

2401	AI Anomaly detection method
2402	AI Fibrosis Treatment

The following 2 projects address "Inventorship" issues.

2410	Transaxle design using AI - 5 scenarios
2411	Therapeutic cancer compound using AI - 2 scenarios

Field of Science/Technology:

Project Details:

Intended Results:
Work locations:
Key Employees:
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Technology or Knowledge Base Level:

Activity #1-1: Activity 1 (Fiscal Year 2024)

Methods of experimentation:

Results:

Conclusion:

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
New ASIC chip design (synapses/micron)	10	20	Yes
ANN Methodology (x)	(not set)	(not set)	No
Malicious attack detection (%)	97	99.9	Yes

This example illustrates the application of the eligibility analysis to claims that recite limitations specific to artificial intelligence, particularly the use of an artificial neural network to identify or detect anomalies.

[Claim 1] An application specific integrated circuit (ASIC) for an artificial neural network (ANN), the ASIC comprising:
a plurality of neurons organized in an array, wherein each neuron comprises a register, a microprocessor, and at least one input; and a plurality of synaptic circuits, each synaptic circuit including a memory for storing a synaptic weight, wherein each neuron is connected to at least one other neuron via one of the plurality of synaptic circuits.

[Claim 2] A method of using an artificial neural network (ANN) for detecting one or more anomalies in a data set using the trained ANN;

[Claim 3] A method of using an artificial neural network (ANN) to detect malicious network packets dropping the one or more malicious network packets in real time; and blocking future traffic from the source address.

Field of Science/Technology:

Micro-electronics (2.02.03)

Project Details:

Intended Results: Develop new processes, Develop new materials, devices, or products, Improve existing processes
Work locations: Research Facility
Key Employees:
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Circuit design HARDWARE

[Claim 1] An application specific integrated circuit (ASIC) for an artificial neural network (ANN), the ASIC comprising:
a plurality of neurons organized in an array, wherein each neuron comprises a register, a microprocessor, and at least one input; and a plurality of synaptic circuits, each synaptic circuit including a memory for storing a synaptic weight, wherein each neuron is connected to at least one other neuron via one of the plurality of synaptic circuits.

In some embodiments, an ANN may be implemented by an application-specific integrated circuit (ASIC). ASICs may be specially customized for a specific artificial intelligence application and provide superior computing capabilities and reduced electricity consumption compared to traditional CPUs

The most significant underlying key variables are:

materials, layouts, connection methods

Technology or Knowledge Base Level:

Activity #1-1: Circuit design Eligible for patent (Fiscal Year 2024)

Methods of experimentation:

While the background explains that "[a]n ANN can be realized through software, hardware, or a combination of software and hardware," the broadest reasonable interpretation of the claimed ANN requires hardware because the claimed ASIC is a physical circuit. The claim recites an ASIC that implements an ANN. The claim is directed to a physical circuit, which is a machine and/or manufacture, and falls within one of the statutory categories of invention.

[Claim 1] An application specific integrated circuit (ASIC) for an artificial neural network (ANN), the ASIC comprising:
a plurality of neurons organized in an array, wherein each neuron comprises a register, a microprocessor, and at least one input; and a plurality of synaptic circuits, each synaptic circuit including a memory for storing a synaptic weight, wherein each neuron is connected to at least one other neuron via one of the plurality of synaptic circuits.

Results:

New ASIC chip design: 17 synapses/micron (70% of goal)

Conclusion:

The claim recites an ASIC that implements an ANN. The claim is directed to a physical circuit, which is a machine and/or manufacture, and falls within one of the statutory categories of invention.

The claim recites a plurality of neurons, which are hardware components comprising a register and a microprocessor, and a plurality of synaptic circuits which together form an ANN.

The claim does not recite any abstract ideas, such as a mathematical concept, mental process, or a method of organizing human activity, such as a fundamental economic concept or managing interactions between people. See MPEP 2106.04(a)(2).

While ANNs may be trained using mathematics, there is no mathematical concept recited in the claim.

The claim is eligible,

AUTHORS NOTE: THIS OUTLINES THE RELATIVE EASE IN DEFINING TECHNOLOGICAL ADVANCEMENT FOR HARDWARE ITEMS SUCH AS CIRUITS VS. AI PROCESSES WHERE THE "HUMAN" USER INPUT CAN NOT BE CLEARY DEFINED.

Significant variables addressed: connection methods, layouts, materials

Uncertainty #2: ANN design SOFTWARE / AI

ANNs are a type of machine learning model used to perform a wide variety of complex tasks, including image recognition, speech recognition, pattern recognition, and detection of anomalies. An ANN is a biologically inspired algorithm that learns from training data.

An ANN can be realized through software, hardware, or a combination of software and hardware. The structure of an exemplary ANN has a series of layers, each comprising one or more neurons arranged in one or more neuron arrays.

In an exemplary embodiment, a neuron may comprise a register, a microprocessor, and at least one input. Each neuron produces an output, or activation, based on an activation function that uses the outputs of the previous layer and a set of weights as inputs. Each neuron in a neuron array may be connected to another neuron via a synaptic circuit.

A synaptic circuit may include a memory for storing a synaptic weight. An exemplary ANN may be a Deep Neural Network having an input layer, an output layer, and a plurality of fully connected hidden layers. ANNs are particularly useful in anomaly detection because they can effectively extract features in linear and nonlinear relationships.

According to the background section, existing systems use various detection techniques for detecting potentially malicious network packets and can alert a network administrator to potential problems.

A difficulty in anomaly detection is that a system must define the boundary between ordinary and anomalous data and accurately classify data as ordinary or anomalous. The line between ordinary and anomalous data may be difficult to determine with cases approaching a boundary and based on an application-specific domain.

For example, small variations may trigger an identification of an anomaly in network security or medicine while relatively larger deviations may be considered normal in less sensitive applications. Furthermore, malicious actors may attempt to make anomalies appear like ordinary activity.

This application provides solutions for using a trained ANN to quickly and accurately identify anomalies as compared to anomaly detection performed using traditional methods.

The most significant underlying key variables are:

detection techniques, variation sensitivity, boundary definition - ordinary vs anomalous

Technology or Knowledge Base Level:

Activity #2-1: General anomaly detection - Ineligible (Fiscal Year 2024)

Methods of experimentation:

[Claim 2] A method of using an artificial neural network (ANN) comprising:
(a) receiving, at a computer, continuous training data;
(b) discretizing, by the computer, the continuous training data to generate input data;
(c) training, by the computer, the ANN based on the input data and a selected training algorithm to generate a trained ANN, wherein the selected training algorithm includes a backpropagation algorithm and a gradient descent algorithm;
(d) detecting one or more anomalies in a data set using the trained ANN;
(e) analyzing the one or more detected anomalies using the trained ANN to generate anomaly data; and
(f) outputting the anomaly data from the trained ANN.

A conventional backpropagation algorithm and a conventional gradient descent algorithm may be used to train the neural network. Gradient descent is an optimization algorithm used to minimize differentiable real-valued multivariate functions. Gradient descent begins by initializing the values of parameters and then applying a gradient descent calculation, which uses mathematical calculations to iteratively adjust the values so they minimize a loss function to optimize the ANN. Backpropagation is the mathematical process of calculating the derivatives and gradient descent is the process of adjusting model parameters using the calculated derivatives to minimize the loss function. Backpropagation is a mathematical calculation for supervised learning of ANNs using gradient descent. Given an ANN and an error function, backpropagation is used to calculate the gradient of the error function with respect to the neural network's weights.

Results:

Steps (a), (b), and (c) are all recited as being performed by a computer. The recited computer is recited at a high level of generality, i.e., as a generic computer performing generic computer functions.

Step (d) recites detecting one or more anomalies in a data set using the trained ANN. The claim does not provide any details about how the trained ANN operates or how the detection is made, and the plain meaning of “detecting” encompasses mental observations or evaluations, e.g., a computer programmer's mental identification of an anomaly in a data set.

The claim does not put any limits on how the continuous data is received, but the background supports the plain meaning of “receiving” as encompassing receiving the data remotely over a network.

The claim also does not limit the plain meaning of “discretizing,” which, as explained in the background, includes any known discretization method, including binning and clustering, as well as numerical discretization, such as rounding continuous data values or performing other basic mathematical calculations that can be performed mentally (see the third paragraph of the background).

Step (c) recites training an ANN using a selected algorithm. The training algorithm is a backpropagation algorithm and a gradient descent algorithm. When given their broadest reasonable interpretation in light of the background, the backpropagation algorithm and gradient descent algorithm are mathematical calculations.

The plain meaning of these terms are optimization algorithms, which compute neural network parameters using a series of mathematical calculations.

The fourth paragraph of the background supports the plain meaning by stating the “gradient descent begins by initializing the values of parameters and then applying a gradient descent calculation, which uses mathematical calculations to iteratively adjust the values so they minimize a loss function.”

Conclusion:

The trained ANN is used to generally apply the abstract idea without placing any limits on how the trained ANN functions. Rather, these limitations only recite the outcome of “detecting one or more anomalies” and “analyzing the one or more detected anomalies" and do not include any details about how the "detecting" and "analyzing" are accomplished. See MPEP 2106.05(f).

AUTHORS NOTE: THIS OUTLINES SOME POTENTIAL DOCUMENTATION ISSUES AND OPPORTUNITIES FOR SRED CLAIMS AS WELL AS PATENTS.

Activity #2-2: Packet method for security - Eligible (Fiscal Year 2024)

Methods of experimentation:

[Claim 3] A method of using an artificial neural network (ANN) to detect malicious network packets comprising:

(a) training, by a computer, the ANN based on input data and a selected training algorithm to generate a trained ANN, wherein the selected training algorithm includes a backpropagation algorithm and a gradient descent algorithm;
(b) detecting one or more anomalies in network traffic using the trained ANN;
(c) determining at least one detected anomaly is associated with one or more malicious network packets;
(d) detecting a source address associated with the one or more malicious network packets in real time;
(e) dropping the one or more malicious network packets in real time; and
(f) blocking future traffic from the source address.

Results:

Malicious attack detection: 99.5 % (86% of goal)

Specifically, "detecting one or more anomalies in network traffic" is a mental process because the claimed detection is a process that is practically performed in the human mind by a human observing network traffic data and using "evaluation, judgment, and opinion" to detect whether an anomaly has occurred

"Unless it is clear that a claim recites distinct exceptions, such as a law of nature and an abstract idea, care should be taken not to parse the claim into multiple exceptions, particularly in claims involving abstract ideas." MPEP 2106.04, subsection II.B (discussing Bilski v. Kappos, 561 U.S. 593 (2010)).

Here, step (a) recites a mathematical concept, and steps (b) and (c) recite mental processes; therefore, claim 3 recites multiple abstract ideas. As discussed above for claim 2, in this case, it is appropriate to consider the limitations together as a single abstract idea rather than as a plurality of separate abstract ideas to be analyzed individually.

Limitations (d)-(f) do not recite mental processes because they cannot be practically performed in the human mind. That is, the human mind is not equipped to detect a source address associated with malicious network packets, drop the malicious network packets in real time, and block future traffic as recited in the claim. See MPEP 2106.04(a)(2), subsection III.A (discussing SRI Int'l, Inc. v. Cisco Systems, Inc., 930 F.3d 1295, 1303 (Fed. Cir. 2019)).

As step (a) and steps (b)-(c) fall within different groupings of abstract ideas (i.e., mathematical concepts and mental processes, respectively), these limitations are considered together as a single abstract idea for further analysis.

Conclusion:

The additional elements in steps (d)-(f), when considered in combination, integrate the abstract idea into a practical application because the claim improves the functioning of a computer or technical field. See MPEP 2106.04(d)(1) and 2106.05(a).

The claimed invention reflects this improvement in the technical field of network intrusion detection. Thus, the claim as a whole integrates the judicial exception into a practical application (Step 2A, Prong Two: YES), such that the claim is not directed to the judicial exception. (Step 2A: NO).

The claim is eligible.

AUTHORS NOTE: THE PATENT RULES PROVIDE ELIGIBILITY AS A RESULT OF IMPROVING A "PRODUCT" (FUNCTIONING OF A COMPUTER) . IN THE CASE OF HARDWARE / SOFTWARE THIS MAY PROVIDE SOME LESSONS FOR SR&ED RELATED CLAIMS - I.E. FOCUS ON IMPROVED PRODUCTS VS PROCESSES?

Significant variables addressed: boundary definition - ordinary vs anomalous, detection techniques, variation sensitivity

Project Name:	AI Fibrosis Treatment	**Start Date:**	2024-03-04
Project Number:	2402	**Completion Date:**	2024-09-30

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
System to identify risk (%)	90	99.5	Yes
develop anti fibrotic eye drop (0= no / 1 = yes)	0	1	Yes
Reduce Post Inflammation (%)	60	90	Yes

Applicant developed a new anti-fibrotic drug, Compound X, that effectively reduces scarring around a microstent implantation site in glaucoma patients at high risk of PI after microstent implant surgery without the undesirable side effects of drug A. In connection with this invention, the applicant filed a patent application disclosing Compound X and describing how it may be topically administered in eye drop form after microstent implant surgery.

The applicant also discovered that PI is a polygenic condition, meaning that it results from the interaction of multiple genes rather than any single gene. Using standard methodologies, the applicant conducted a large-scale genome wide association (GWA) study on PI in glaucoma patients and identified 37 informative single-nucleotide polymorphisms (SNPs) that have a statistically significant association with PI. The application defines “informative SNPs” as the 37 SNPs identified in the GWA study. These informative SNPs serve as genetic markers for the genes that give rise to PI.

Field of Science/Technology:

Pharmacogenomics, gene-based therapeutics (3.04.04)

Project Details:

Intended Results:	Develop new processes, Develop new materials, devices, or products
Work locations:	Research Facility
Key Employees:	
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Glaucoma is a leading cause of blindness globally. The most common form is open angle glaucoma, in which irreversible vision loss results from cell and optic nerve damage caused largely by poor drainage of aqueous humor from the eye. Depending on condition severity and the timing of the diagnosis, treatment can include lifestyle adjustments, pharmaceutical eye drops, laser eye surgery, or drainage device implants to facilitate healthy drainage.

While newer drainage devices, such as microstents, are more comfortable than earlier drainage devices, post-surgery scarring and inflammation due to fibrosis remain issues. Commonly prescribed anti-fibrotic drugs, such as drug A, can reduce scarring but do so non-specifically while causing more inflammation (“post-implantation inflammation” or “PI”) that further damages the eye.

The most significant underlying key variables are:

treatments - drops, microstints, surgery, modelling SNPs - AI (unresolved), drop formulation

Technology or Knowledge Base Level:

Activity #1-1: Screening method AI based - Ineligible (Fiscal Year 2024)

Project Name:	AI Fibrosis Treatment	**Start Date:**	2024-03-04
Project Number:	2402	**Completion Date:**	2024-09-30

Methods of experimentation:

[Claim 1] A post-surgical fibrosis treatment method comprising:
(a) collecting and genotyping a sample from a glaucoma patient to a provide a genotype dataset;
(b) identifying the glaucoma patient as at high risk of post-implantation inflammation (PI) based on a weighted polygenic risk score that is generated from informative single-nucleotide polymorphisms (SNPs) in the genotype dataset by an ezAI model that uses multiplication to weight corresponding alleles in the dataset by their effect sizes and addition to sum the weighted values to provide the score; and
(c) administering an appropriate treatment to the glaucoma patient at high risk of PI after microstent implant surgery.

From the GWA study data, the applicant developed a polygenic risk score (PRS) model by classic clumping and thresholding methods to provide a weighted PRS. As is known in the art, a PRS is a single value estimate of an individual's relative risk for a given phenotype or condition based on the individual's genotype.

In brief, after collecting a sample from a patient, the sample is sequenced and genotyped to provide a genotype dataset. Alleles in the genotype dataset corresponding to informative SNPs selected from the GWA study are identified, tallied, and weighted (using effect sizes derived from GWA study summary statistics as weights). A PRS is then generated as a sum of the weighted values. Sample collection, sequencing, and genotyping for the purposes of providing a genotype dataset may be carried out by conventional methods known in the art.

The applicant also discloses a computer-implemented machine learning model (referred to as "the ezAI model" for the purposes of this disclosure) and its clinical applications.

Given an input of a patient's genotype dataset, the ezAI model calculates a weighted PRS from informative SNPs in the dataset—using multiplication to weight corresponding alleles in the dataset by their effect sizes and addition to sum the weighted values.

Using the same weights and informative SNPs, the ezAI model improves upon the base PRS model by determining a risk score and providing a classification in less time.

Results:

- System to identify risk : 97 % (73% of goal)

The specification discloses a method of identifying glaucoma patients at high risk of PI using this PRS model. An identification of a patient as being at high risk of PI is made by ranking a weighted PRS once the score has been generated.

The application defines a "glaucoma patient at high risk of PI" as a glaucoma patient having a weighted PRS in the top quartile of PRS values when ranked against reference PRS values established during PRS model development.

The disclosure teaches that determining patient risk using a weighted PRS as disclosed and accordingly customizing treatment lends to better prognosis after implant surgery.

Limitation (b) also recites "a weighted PRS that is generated from informative SNPs in the genotype dataset by an ezAI model that uses multiplication to weight corresponding alleles in the dataset by their effect sizes and addition to sum the weighted values to provide the score."

this limitation requires a mathematical calculation. Namely, an arithmetic calculation (multiplication to weight alleles by their effect sizes and addition to sum the weighted values) is required to generate a weighted risk score. Limitation (b) hence recites a "mathematical calculation" and so falls into the "mathematical concepts" grouping of abstract ideas.

For instance, given a genotype dataset, a physician would identify, tally, and weight alleles corresponding to informative SNPs present in the dataset by their effect sizes, then sum the resulting values to generate a risk score. See MPEP 2106.04(a)(2), subsection I.C.

This limitation also falls into the "mental process" grouping because it requires an assessment of the genotype dataset in order to identify informative SNPs in evaluating patient risk. Moreover, the recited mathematical calculation is simple enough that it can be practically performed in the human mind.

Even if most humans would use a physical aid, like a pen and paper or a calculator, to make such calculations, the use of a physical aid would not negate the mental nature of this limitation.

Conclusion:

The data gathering activities in limitation (a) are recited at a high level of generality and have been recognized by the courts as being routine laboratory techniques (analyzing DNA to provide sequence information or to detect allelic variants is conventional in the art); MPEP 2106.05(d), subsection II.

The specification otherwise only describes carrying out sample collection and genotyping by conventional methods.

Consequently the additional elements individually or in combination do not provide an inventive concept;

While the disclosure states that “the ezAI model improves upon the base PRS model by determining a risk score and providing a classification in less time,” there is no improvement to the functioning of a computer nor to any other technology.

At best, the claimed combination amounts to an improvement to the abstract idea of determining patient risk rather than to any technology. See MPEP 2106.05(a). Thus, even when considering the elements in combination, claim 1 as a whole does not integrate the recited exception into a practical application. (Step 2A, Prong Two: NO).

The claim is not eligible.

AUTHORS NOTE: THESE LIMITS RELATE TO RESULTS GENERATED BY THE AI SYSTEM INSTEAD OF ISSUES WHICH INVOLVED / REQUIRED "SIGNIFICANT INPUT" FROM THE HUMAN RESEARCHER.

Activity #1-2: Custom eyedrops - Eligible despite AI result (Fiscal Year 2024)

Methods of experimentation:

[Claim 2] The method of claim 1, wherein the appropriate treatment is Compound X eye drops.

From the GWA study data, the applicant developed a polygenic risk score (PRS) model by classic clumping and thresholding methods to provide a weighted PRS. As is known in the art, a PRS is a single value estimate of an individual’s relative risk for a given phenotype or condition based on the individual’s genotype.

In brief, after collecting a sample from a patient, the sample is sequenced and genotyped to provide a genotype dataset. Alleles in the genotype dataset corresponding to informative SNPs selected from the GWA study are identified, tallied, and weighted (using effect sizes derived from GWA study summary statistics as weights).

A PRS is then generated as a sum of the weighted values. Sample collection, sequencing, and genotyping for the purposes of providing a genotype dataset may be carried out by conventional methods known in the art.

Results:

- develop anti fibrotic eye drop: 1 0= no / 1 = yes (100% of goal) -- Successful product
- Reduce Post Inflammation: 93 % (110% of goal)

An abstract idea is used to identify the patient as belonging to a specific patient population (glaucoma patients at high risk of PI), and the patient is then administered a treatment (Compound X eye drops instead of any common anti-fibrotic treatment, such as drug A, after microstent implant surgery) that is particular to that specific patient population (glaucoma patients at high risk of PI).

Relying on the determination of patient risk to administer Compound X eye drops to glaucoma patients at high risk of PI after microstent implant surgery is therefore a particular treatment for a medical condition such that the claim as a whole integrates the judicial exception into a practical application. See MPEP 2106.04(d)(2). (Step 2A, Prong Two: YES).

Conclusion:

The claim is eligible.

AUTHORS NOTE: USE OF AI RESULTS TO CREATE NEW PRODUCT WHICH IS ELIGIBLE FOR PATENT.

AUTHORS NOTE: THE PATENT RULES PROVIDE ELIGIBILITY AS A RESULT OF IMPROVING A "PRODUCT" (DEVELOPMENT OF THE NEW EYE DROP FORMULATION) .

IN THE CASE OF LIFE SCIENCES THIS MAY PROVIDE SOME LESSONS FOR SR&ED RELATED CLAIMS - I.E. FOCUS ON NEW/IMPROVED PRODUCTS VS. PROCESSES?

Significant variables addressed: drop formulation, treatments - drops, microstints, surgery

Project Name:	Transaxle design using AI	**Start Date:**	2024-01-01
Project Number:	2410	**Completion Date:**	2024-12-31

Project Details:

Scientific or Technological Objectives:

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results: Develop new materials, devices, or products
Work locations: Research Facility
Key Employees:
Evidence types:

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Technology or Knowledge Base Level:

Activity #1-1: AI generated result - Ineligible (Fiscal Year 2024)

Methods of experimentation:

Ruth and Morgan’s contribution Analysis of the contribution
Recognized a problem (needing a transaxle) GP2-
Prompted the AI system to solve the problem
Reviewing the AI output

Results:

Conclusion:

GP3 - Recognition and appreciation of an invention without a contribution to conception is not sufficient.

Recognition of a problem does not rise to the level of Conception Prompt is only a restatement of the problem, no inventive contribution in how the prompt is constructed

Activity #1-2: Transaxle to practice - Ineligible (Fiscal Year 2024)

Methods of experimentation:

proof of concept prototype

Ruth and Morgan’s contribution
Selected steel for the building the design: Selection of a well-known material is insignificant in quality when compared to the full scope of the claimed invention. (Second Pannu factor)

Morgan Recognized a problem; Prompted the AI system to solve the problem; Reviewing the AI output
As in scenario 1, Ruth and Morgan’s contributions to identifying a problem and prompting Puerto5 to solve the problem are not significant.

Reduced the transaxle to practice
GP 3- Reducing an invention to practice alone is not a significant contribution that rises to inventorship

Results:

Conclusion:

Activity #1-3: Redesign on horizontal plane - Eligible (Fiscal Year 2024)

Methods of experimentation:

Ruth and Morgan's Contribution
Created the new design based upon a suggestion from the AI system including:
• Elongated case
• Specific placement of elements in cases
• Specific location of separation in casing

Results:

GP 1 – a natural person's use of an AI system in creating an AI-assisted invention does not negate the person's contributions as an inventor
Clip fastener (Morgan) Original design by a natural person and a significant element of the claimed invention

Conclusion:

Activity #1-4: AI input on fabrication - Eligible (Fiscal Year 2024)

Methods of experimentation:

Results:

Conclusion:

Activity #1-5: AI system designer - Ineligible inventor (Fiscal Year 2024)

Methods of experimentation:

Results:

Conclusion:

Project Name:	Therapeutic cancer compound using AI	**Start Date:**	2024-01-01
Project Number:	2411	**Completion Date:**	2024-12-31

Project Details:

Scientific or Technological Objectives:

Field of Science/Technology:

Health-related biotechnology (3.04.01)

Project Details:

Intended Results:	Develop new materials, devices, or products
Work locations:	Research Facility
Key Employees:	
Evidence types:	

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Technology or Knowledge Base Level:

Activity #1-1: AI provided feedback - Eligible (Fiscal Year 2024)

Methods of experimentation:

Results:

Conclusion:

Activity #1-2: AI provided solution - Ineligible (Fiscal Year 2024)

Methods of experimentation:

Results:

Conclusion: