SR&ED Newsletter
Edition 2012 – 5

Recent developments to Scientific Research & Experimental Development (SR&ED) project management & tax credit claims.

Contents

Recent SR&ED Tax Cases & Related Issues

Copies of the judgment are available from the Tax Court of Canada website.[1]

Airmax Technologies – eligibility of HVAC improvement

Facts:

The appellant, 1726437 Ontario Inc. o/a Airmax Technologies, is an installer of heating, ventilation and air conditioning systems in residential homes.

STANDARD PRACTICE: At the time it began its development work, the appellant had determined that existing HVAC systems used for townhouse installations did not operate efficiently. The systems that were on the market at the time did not distribute heating evenly throughout the living space of multi-storey townhouses and they operated at high noise levels.

OBJECTIVES: The appellant set out to correct these problems with the development of a new HVAC system.

The appellant set the following technological objectives for the overall system:

(1) Achieving a sound level reduction from 60 to 40 dB;
(2) Achieving constant static pressure;
(3) Adapting a foreign boiler to meet North American standards;
(4) Achieving the required BTUs,
(5) Adapting an electronically commutated motor (ECM) for use in the system.

In 2007 and 2008, the appellant worked on an SR&ED project named "High Static High Velocity Fan Coil System Development" ("HVAC System").

ELIGIBLE WORK: During the 2007 taxation year SR&ED activities focused on the design of a quieter air diffuser. The Minister accepted that this work was eligible SR&ED.

INELGIBLE WORK: To reduce noise levels further, the appellant undertook testing of the flexible duct used as the conduit to move the hot air generated at the heating source. The appellant put holes in the core of the flexible duct for that purpose, experimented with the size, number and position of the holes, and adopted those variables which reduced noise levels the most.

In 2008, the appellant incurred expenses to bring a European-sourced boiler into conformity with North American standards & undertook testing of ECMs to ensure that they could be programmed at the speeds necessary to meet the design requirements

The Minister of National Revenue (the "Minister") disallowed most of the expenses claimed by the appellant on the grounds that the activities constituted **routine engineering.**

Issues:

1) Was the work SR&ED?

Other than those recognized as such by the Minister, did the appellant's activities in the 2007 and 2008 taxation years constitute SR&ED?

2) Effects of informal appeal

What are the consequences of the appellant's election to have its appeal heard under the informal procedure?

Relevant legislation and analysis:

1) Was the work SR&ED?

The definition of SR&ED[2] is based on a "catch and release" concept. The definition first includes a broad category of development activities under paragraphs (*a*) to (*c*), then items otherwise included are excluded under paragraphs (*e*) to (*k*).

The judge commented:

> "The evidence shows that the system was unique in the market insofar as it utilized:
>
> - Higher than usual pressure in response to narrower duct work used in narrow multi-storey townhouses &
>
> - an unconventional heat source unlike more commonly used indirect-fired furnaces &
>
> - there was **technological uncertainty** with respect not only to **noise, but also to space and efficiency** with those types of systems."

[1] Tax Court of Canada website [www.tcc-cci.gc.ca]

[2] ITA 248(1) - definition of Scientific Research & Experimental Development

2) Effects of informal appeal

The judge referred to the limits[3] under the Tax Court of Canada Act, which reads as follows:

> **"**Every judgment that allows an appeal referred to in subsection 18(1) shall be deemed to include a statement that the aggregate of all amounts in issue **not be reduced by more than $12,000** or that the amount of the loss in issue not be increased by more than $24,000, as the case may be."

Ruling & Rationale: WIN – variables of experimentation = hypotheses

The judge then ruled,

1) Was work SR&ED?

"Considering the evidence as a whole, I am of the opinion that the appellant has demonstrated that it maintained a level of **record-keeping** that illustrates that it **identified a problem, developed hypothetical solutions, tested them**, and modified its approach in **response to** the results."

2) Effects of informal appeal

"The amount of the appellant's additional refundable **ITCs for the 2008 taxation year is limited to $12,000** notwithstanding the fact that its qualified SR&ED expenditures for that year totaled $387,553."

Implications and author's commentary

1) Was work SR&ED?

Since this was an informal appeal it did not provide the degree of detail which we might see under a general procedure.

The judge sited the experimentation of the different variables as "hypothetical solutions."

In the author's opinion the **client would have had an easier time** if it had been able to:

-identify & rank the
-**key variables of uncertainty** / experimentation.

As a result, in the next section we have developed a **project rewrite** illustrating issues which might have been present in this or similar SR&ED projects.

2) Effects of informal appeal:

Claim limited to $12,000/year but decision within 1 year!

Despite the fact that the client would have been **entitled to** federal credits of ($387,553 x 35% = **$135,643**) under the general procedure the **settled for $12,000** under the informal procedure.

In effect they **settled for less that 10% of total credit**s in dispute, however, the following advantages of the informal vs. general procedure made this a necessary decision:

General Procedure (tax court)

- generally cost $40,000+
- require use of a lawyer (tax litigator)
- take 3+ years
- during which period all SR&ED claims will be held if similar issues

Informal Procedure (tax court)

- $100 application fee
- client or accountant can represent
- no lawyer required
- takes < 1 year
- limited to $12,000 / year
- **provides legal precedent for future years**

As a result there are few incentives & huge barriers to prevent taxpayers from using the general procedure no matter how much their claim has merit.

In the author's opinion the CRA desperately needs an arbitration method to get disputed claims settled **quickly.**

Sadly the informal procedure seems to be the best current method to achieve any type of "justice."

Recommendation: Until a better method is developed perhaps the **threshold amounts could be raised for SR&ED related claims**?

Notable quote:

"There is nothing wrong with change, if it is in the right direction"
- Sir Winston Churchill

[3] section 18.1 of the TCCA

Airmax – project description with comments on eligibility

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Footprint (m2)	20	5	Yes
Cost ($)	60000	25000	Yes
Noise (DB)	60	20	Yes
Constant Static pressure (% variance)	10	1	Yes
Ventilation rate (CFM/occupant)	20	25	Yes
Air mixing % (Ev) (%)	60	80	Yes
CO2 concentrations (PPM)	800	600	Yes
SEER (efficiency rating) (rating)	10	12	Yes

[NOTE: THIS PROJECT EXAMPLE IS REPRODUCED FROM DETAILS PROVIDED IN THE TAX COURT OF CANADA RULING ON AIRMAX TECHNOLOGIES, 2012 (TCC) 376. Copies of the judgment are available from the Tax Court of Canada website [www.tcc-cci.gc.ca].

SINCE THE MOTION WAS AN INFORMAL APPEAL THERE WAS ONLY SUMMARY EVIDENCE PROVIDED AT THE TRIAL.

AS A RESULT WE HAVE ADDED ADDITIONAL GUIDANCE & EXAMPLES OF POTENTIALLY ELIGIBLE WORK IN THE AIR DISTIBUTION INDUSTRY.

In addition to the claimants own cost & performance goals there may be additional objectives created by;

- ASHRAE or other industry standards eg. for air quality / ventilation rates

As illustrated in this example it is important to list all significant & QUANTIFIABLE objectives since they tend to "stack up" or combine to create the technological uncertainties.

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	8 sites / articles	8 articles outlining design methods of similar systems were discovered but none met the stated objectives.
Patent searches	14 patents	14 different patents were examined regarding both component design & concepts to integrate entire systems.
Competitive products or processes	12 products	Concepts from 12 competitive systems were examined.
Similar prior in-house technologies	3 products / processes	
Potential components	55 products	
Queries to experts	4 responses	received 4 responses via HVAC industry blogs re. alternate part designs

DEPARTURES FROM STANDARD PRACTICE:

The design of this system was unique in the market insofar as it utilized higher than usual pressure in response to the problem of the narrower duct work used in narrow multi-storey townhouses.

It also contemplated using an unconventional heat source that also provided domestic hot water, unlike those more commonly used indirect-fired furnaces.

AUTHOR'S NOTE: IDEALLY THE CLAIMANT WOULD ATTEMPT TO OUTLINE ALL:

- "DUE DILIGENCE" PERFORMED IN ORDER TO

- “BENCHMARK” THE LEVEL OF TECHNOLOGY WHICH WOULD BE

- "READILY AVAILABLE TO SOMEONE SKILLED IN THE ART."

THE CRA AND COURTS REFER TO THIS AS "STANDARD PRACTICE" FOR THE INDUSTRY.

THERE IS NO MINIMUM REQUIRED LEVEL OTHER THAN IT IS "REASONABLE WITHIN THE BUSINESS CONTEXT OF THE FIRM."

Field of Science/Technology:

Thermodynamics (2.03.03)

Scientific or Technological Advancement:

Uncertainty #1: component design & integration

We have attempted to list examples of

- the top 5 variables of experimentation along with
- an outline of potential issues (or sub-variables) to be investigated

In addition to those listed experimental development in this and similar HVAC areas may include contemplation of:

- manifold pressures vs. BTU inputs
- warm vs. cold air systems
- constant vs. variable air volumes

The most significant underlying key variables are:

- Coil - shape, depth, location,
- Components - diffuser vs. ducts vs. boiler vs. ECM,
- Spacing - components, duct vents,
- Diffuser - shape, aspiration rate, location,
- Duct - holes: size, # & position, material, shape (unresolved)

Activity #1-1: Diffuser (accepted by CRA) (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives
Process trials:	10 runs / samples
Physical prototypes:	10 samples (with 50 revisions)

One of the major drawbacks of an HVAC system is noise due to the fact that the system operates at a high air pressure level which is necessary to move air vertically between the multiple levels of a townhouse.

The appellant determined that the air diffusers in use in the market place contributed to the high noise levels, and undertook development work in the 2007 taxation year which ultimately led to the design of a quieter air diffuser.

Results:

- Noise: 40 DB (50% of goal)
- Air mixing % (Ev): 75 % (75% of goal)

The Minister (CRA) accepted that this work was eligible.

Conclusion:

IDEALLY THE CLAIMANT WOULD PROVIDE ANY FURTHER CONCLUSIONS ON THE STATED VARIABLES OF UNCERTAINTY.

Significant variables addressed: Diffuser - shape, aspiration rate, location

Documentation:

- Uploaded to RDBASE.NET: Airmax 2012TCC376.pdf (253KB)

Activity #1-2: Duct (Challenged by CRA) (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives
Process trials:	12 runs / samples

To reduce noise levels further, the appellant undertook testing of the flexible duct used as the conduit to move the hot air generated at the heating source.

The appellant put holes in the core of the flexible duct for that purpose, experimented with the size, number and position of the holes, and adopted those variables which reduced noise levels the most.

Results:

- Noise: 32 DB (70% of goal)
- Ventilation rate: 23 CFM/occupant (60% of goal)
- Air mixing % (Ev): 77 % (85% of goal)

Conclusion:

The judge noted that,

"All of the constituent parts of the appellant's system needed to function in unison to achieve the appellant's design objectives. For example, the appellant undertook testing on the flexible ductwork together with the diffuser for the purpose of ensuring that the system operated within the specified noise parameters."

Significant variables addressed: Components - diffuser vs. ducts vs. boiler vs. ECM, Duct - holes:size, # & position, material, shape, Spacing - components, duct vents

Activity #1-3: Furnace ECM x-n (challenged) (Fiscal Year 2013)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives
Process trials:	50 runs / samples

In 2008, the appellant incurred expenses to bring a European-sourced boiler into conformity with North American standards.

The appellant also undertook testing of ECMs to ensure that they could be programmed at the speeds necessary to meet the design requirements set for the appellant's HVAC system while still meeting the manufacturer's safety specifications, which were required to be adhered to in order to ensure coverage under the manufacturer's warranty.

The ECMs used in the test were purchased from a Korean manufacturer, Essen Tech. The appellant worked with a consultant to develop new program settings for the control board. The evidence shows that the appellant had the right to use the intellectual property generated from the testing, along with Essen Tech.

NOTE: THE ABOVE DETAILS WERE PROVIDED TO THE TAX COURT. IDEALLY A CLAIMANT WOULD ILLUSTRATE ADDITIONAL DETAILS RELATED TO ANY INVESTIGATIONS OF THE VARIABLES OF UNCERTAINTY.

Results:

- Footprint: 7 m2 (86% of goal)
- Cost: 30000 $ (85% of goal)
- Noise: 25 DB (87% of goal)
- Constant Static pressure: 0.5 % variance (105% of goal)
- Ventilation rate: 28 CFM/occupant (160% of goal)
- Air mixing % (Ev): 86 % (130% of goal)
- CO2 concentrations: 850 PPM (no improvement)
- SEER (efficiency rating): 12 rating (100% of goal)

According to the judge,

"The evidence demonstrates that the appellant identified the problems with, and deficiencies of, existing HVAC systems.

In response, the appellant developed a testing site to conduct testing with respect to its diffusers, the integration of the boiler into its system, the programming of the ECM, and the relevant safety and operational standards. Experiments were run, the results were collected and modifications were made."

Conclusion:

Significant variables addressed: Coil - shape, depth, location, Components - diffuser vs. ducts vs. boiler vs. ECM, Spacing - components, duct vents

Key Criteria Summary

R&D Base demo

1201 - Airmax (2012 TCC Case) - HVAC development

Benchmarks:

Internet searches: 8 sites / articles
Patent searches: 14 patents
Competitive products or processes: 12 products
Similar prior in-house technologies: 3 products /
Potential components: 55 products
Queries to experts: 4 responses

Objectives:

Footprint: 5 m2
Cost: 25000 $
Noise: 20 DB
Constant Static pressure: 1 % variance
Ventilation rate: 25 CFM/occupant
Air mixing % (Ev): 80 %
CO2 concentrations: 600 PPM
SEER (efficiency rating): 12 rating

Uncertainty: 1 - component design & integration

Key Variables: Coil - shape, depth, location, Components - diffuser vs. ducts vs. boiler vs. ECM, Diffuser - shape, aspiration rate, location, Duct - holes:size, # & position, material, shape, Spacing - components, duct vents

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Diffuser (accepted by CRA)	Analysis / simulation: 100 alternatives Process trials: 10 runs / samples Physical prototypes: 10 samples ... prototype revisions: 50 revisions	Noise: 40 DB (50 %) Air mixing % (Ev): 75 % (75 %)	Diffuser - shape, aspiration rate, location	1,250.00	0.00	0.00	2012
2 - Duct (Challenged by CRA)	Analysis / simulation: 100 alternatives Process trials: 12 runs / samples	Ventilation rate: 23 CFM/occupant (60 %) Noise: 32 DB (70 %) Air mixing % (Ev): 77 % (85 %)	Duct - holes:size, # & position, material, shape Spacing - components, duct vents	1,000.00	0.00	0.00	2012
3 - Furnace ECM x-n (challenged)	Analysis / simulation: 100 alternatives Process trials: 50 runs / samples	Footprint: 7 m2 (86 %) Cost: 30000 $ (85 %) Noise: 25 DB (87 %) Constant Static pressure: 0.5 % variance (105 %) Ventilation rate: 28 CFM/occupant (160 %) Air mixing % (Ev): 86 % (130 %) CO2 concentrations: 850 PPM (-25 %) SEER (efficiency rating): 12 rating (100 %)	Coil - shape, depth, location Components - diffuser vs. ducts vs. boiler vs. ECM Spacing - components, duct vents	500.00	0.00	0.00	2013

New CRA software example – what is NOT SR&ED

On November 1, 2012 the CRA hosted a working session during which they presented the following project example to stakeholders.

Sadly, the CRA then claimed that this was NOT intended to be an example of eligible work!

Author's commentary:

Having spoken to over 20 participants at this meeting the author proposes the following questions:

1) Why did the CRA waste half a day of time for nearly 80 participants to illustrate what is NOT SR&ED?

2) Does the CRA have ANYONE BOTH WILLING & CAPABLE of developing an example of a potentially eligible project?

The CRA Directorate (Ottawa) has been promising to provide improved SR&ED descriptions for over 1 year but nothing has been released.

Without such direction the entire system is experiencing tremendous inefficiencies.

As a result software RTA's are beginning to claim they "can't see the technological advancement" in ANY software development.

This situation is expected to worsen due to the fact that the RTA's:

- Have NO examples (or ideas) of
- relevant evidence of technological advancement.

Recommendations:

We desperately need to have **someone within the CRA** leadership:

a) with both the skills & direction to **create at least 1 eligible project example &/or**

b) the wisdom **to allow industry & practitioners to do so.**

Description – revised for potential eligibility

Since there currently appears to be NO intention or ability of the CRA to develop such examples we have chosen to:

- Add details & issues of similar software projects which,

- MIGHT be eligible as SR&ED including,

- the rational for this eligibility.

While this project itself is not typical of a strong SR&ED project we propose that the rationale for eligibility is what is most important.

Notable quote:

"Leaders don't create followers, they create more leaders."

- Tom Peters

CRA – SR&ED software project description as provided

New Web techniques for animation & quasi-real time interactivity in browsers

On November 1, 2012 the CRA hosted a working session during which they presented the following project example to stakeholders.

CASE B

New Web techniques for animation & quasi-real time interactivity in browsers

Technological context: The evolution of tools, platforms, operating systems, and programming languages continues to accelerate. From an approach that was originally at a very low level (machine language, assembler, etc.) and that allowed complete control of processing resources (often at the expense of complexity), we now see the creation of new, very high-level tools (in terms of functional integration). And yet, despite the fact that users have increasing access to highly sophisticated development tools to simplify their work, it must be noted that very often these tools are so specialized that they sometimes fall short with regard to the ever-growing needs of the users. Development work can thus become more complex, at different levels (system, module, components, etc.) rather than simplified.

Background: The WOW company designs and implements interactive game Web applications that are meant to offer users very high-quality animation and interactivity, almost equivalent to those of video games.

CASE B - Continued

The development of these applications is a significant challenge, given the multiple constraints associated with the Internet. For example:

- bandwidth, which varies greatly depending on each user's network capacity;
- transmission delays (latency), the limiting characteristics of communication;
- peak-load levels that can be much higher than average; and the random nature of user interactivity.

CASE B - Continued

Not reinventing the wheel:

In the context of developing these applications, to resolve the technical problems above, the company undertook several tasks:

It is attempting to select and optimize its development environment to be as efficient as possible in the pursuit of its objectives (i.e. achieving the desired software functionality and minimizing the resources required).

It is making use of a number of existing, recent technologies (some of which are still in the embryonic stages) to help in the achievement of its fluid animation and interactivity objectives (Web Services, Flash, Flex, AJAX, various scripting languages, etc.).

It is investigating all types of software/module, whether they are Open Source (Open Source Software or OSS) or commercial (third party software), with the goal of integrating as many existing components as possible—components it will not have to develop—to improve the performance of its applications.

CASE B - Continued

Discussion questions:

- At what level can technological advancement be achieved (in terms of programming level and/or reuse/modification of modules, etc.)?
- Will the Open Source nature of some software/modules/components affect eligibility?
- Will the fact that it is attempting to combine software and components, whether they are Open Source (OSS) or commercial, affect SR&ED eligibility?

Project Details: SR&ED software project description – rewritten for potential eligibility

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Average Response time (seconds)	2	0.3	Yes
Data structures - number/complexity	(not set)	(not set)	No
Average memory use (bytes / query)	15000	5000	Yes
Maximum number of concurrent users (users)	1000	25000	Yes
CPU usage (% busy)	70	30	Yes
Stability (mean time between failures) (# transactions)	11000	100000	Yes

[NOTE: THIS PROJECT EXAMPLE IS REPRODUCED FROM DETAILS PROVIDED IN THE CRA'S NOVEMBER 1, 2012 SR&ED EXTERNAL STAKEHOLDER'S EVENT IN MISSISSAUGA, ONTARIO.

SADLY THE CRA CLAIMED THAT THEIR SAMPLE PROJECT LACKED THE DETAIL TO DETERMINE ELIGIBLITY.

AS A RESULT WE HAVE ADDED ADDITIONAL GUIDANCE & EXAMPLES OF POTENTIALLY ELIGIBLE WORK.

THIS IS INTENDED AS A STARTING POINT FOR BOTH THE CRA & CLAIMANTS TO UNDERSTAND HOW & WHY THE PROJECT MAY QUALIFY.]

The company intends to make use of a number of existing, recent technologies (some of which are in the embryonic stages) to help in the achievement of:

- Fluid animation &
- Interactivity objectives (web services, Flash/Flex, AJAX, various scripting languages, etc.)

EXAMPLES OF OTHER ISSUES WHICH COULD BE ADDRESSED INCLUDE: Consider a system that would like to run three different distributions of both:

- Windows (XP, Vista & 7)
- Linux (RedHat, Debian & Mandrake).

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	16 sites / articles	Examined 16 articles & blogs on suitable methods. These provided ideas as to some of the technology hurdles to be addressed.
Competitive products or processes	14 products	Several competitors had solutions which addressed one of more of our objectives. Most of these were closed source or proprietary so we were unable to access or review the source code.
Similar prior in-house technologies	3 products / processes	We examined 3 of our existing game platforms & how they might be redeveloped / deployed into improved applications.
Potential components	2 products	We spoke with Microsoft & Linux Redhat support team for ideas on how to use their solutions. Some of these were used to develop our initial prototype.
Queries to experts	2 responses	Once a preliminary spec of the development environment was documented we hired 2 separate consultants to provide input and feedback.

CRA Background to this example:

Technological context: The evolution of tools, platforms, operating systems, and programming languages continues to accelerate.

From an approach that was originally at a very low level (machine language, assembler, etc.) and that allowed complete control of processing resources (often at the expense of complexity), we now see the creation of new, very high-level tools (in terms of functional integration).

Despite the fact that users have increasing access to highly sophisticated development to simplify their work, it must be noted that often these tools are so specialized they sometimes fall short with regards to the ever-growing needs of the users.

Development work can thus become more complex, at different levels (system, module, components, etc.) rather than simplified.

CRA Project example:

The WOW company designs and implements interactive game Web applications that are meant to offer users very high-quality animation and interactivity, almost equivalent to those of video games.

Field of Science/Technology:

Computer sciences (1.02.01)

Scientific or Technological Advancement:

Uncertainty #1: Technology constraints & related variables of experimentation

The CRA project identified technology "constraints" with respect to optimal use of the internet including methods to address;

• optimal platforms or methods use in web services vs. Flash, Flex, AJAX &/or various scripting languages,
• bandwidth, which varies greatly depending on each user's network capacity,
• transmission delays (latency), the limiting characteristics of communication &
• peak-load levels that can be much higher than average; and the random nature of user interactivity.

AUTHORS NOTE: THE IDENTIFICATION OF THESE "OBJECTIVES" & RELATED "VARIABLES OF EXPERIMENTATION" FORM THE BASIS OF THE "CONTROLLED EXPERIMENTATION."

UNLESS THE CRA CAN DEMONSTRATE THAT THESE SOLUTIONS WERE "READILY AVAILABLE" AT THE OUTSET OF THE WORK:

- ANY WORK RELATED TO THE RESOLUTION OF THESE VARIABLES
- WOULD REPRESENT ELIGIBLE ACTIVITIES.

The most significant underlying key variables are:

- **Threads vs. processes-kernel vs. user level binding,**
- **Scheduling - queue sizes, levels, priorities,**
- **Locking methods - spinlock, muteses, conditions,**
- **Web services vs. Remoting / Flash- Flex vs. AJAX,**
- **User memory-virtual, mapped files, heaps, threads**

Activity #1-1: Web services vs. Remoting / Flash- Flex vs. AJAX (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Process trials:	120 runs / samples

THE FOLLOWING IS A POTENTIALLY ELIGIBLE ACTIVITY BASED ON THE CRA EXAMPLE:

There are several different means of bringing XML into the Flash application. The data can be brought in by a HTTP request, a SOAP-based web service, and through Flash Remoting.

Initially we compared these methods in the areas of performance, security and implementation.

WEB SERVICES, HTTP or SOAP-based transfers VS. REMOTING:

Web services, HTTP or SOAP-based data transfer are great if you are only using simple data transfers between the client and host.

Where web services fall down is when the data structures passed back and forth become too complex or when the number of different data structures passed back and forth become too large.

We recognized that remoting overcomes these problems by providing a heavyweight framework that handles the serialisation for you however remoting is not suitable for small scale or varied server protocol stuff though since

- You have to synchronise class structures between server and client;
- you can only communicate with a compatible remoting servers and
- the framework adds overhead to the client size and complexity.
- HTTP services bringing in XML requires little in the way of server modifications. Remoting requires a component to be installed on your server (unless you are using ColdFusion). Web services require programming the web service on your server.

The issue was to identify the correct balance between choosing either of these two procedures as the starting point for a custom client development project.

We preceded to test 1,000 sample queries under both scenarios and discovered that certain types of queries (types X & Y) were better suited to webservices whereas types A through E were better suited to remoting.

We then proceeded to develop a hybrid technique to use both methods.

Results:

- Average Response time: 1.8 seconds (11% of goal)
- Average memory use: 14000 bytes / query (10% of goal)
- Maximum number of concurrent users: 1500 users (2% of goal)

NOTE: THE CRA EXAMPLE SITED THE ISSUES IN THIS ACTIVITY. IN REALITY MUCH OF THIS WORK IS OFTEN MARKET RESEARCH: RELATED TO DETERMINING THE LIMITATIONS OF EXISTING TECHNOLOGIES.

THIS WOULD OFTEN BE PART OF THE "DUE DILIGENCE" PROCESS UNLESS / UNTIL THE CLAIMANT CAN IDENTIFY "VARIABLES" OF UNCERTAINTY AS THE BASIS OF THEIR EXPERIMENTATION.

Conclusion:

Whether AMF via Remoting faster than an XML Service depends on the size of the data you are passing back and forth.

In our case Scenarios X & Y were better suited to _____. Scenarios A through F were better services using AMF remoting. NOTE: IDEALLY THE CLAIMANT WOULD IDENTIFY SCENARIOS FOR WHICH THE SOLUTIONS WERE NOT "READILY APPARENT" AT THE OUTSET OF THE WORK.

Significant variables addressed: Web services vs. Remoting / Flash- Flex vs. AJAX

Activity #1-2: Prototype testing - latency issues MS Windows (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Process trials:	300 runs / samples
	Analyzed API & hardware control loop strategies to address latency issues

Latency issues - MS Windows:

On Microsoft Windows, it appears that the timing of commands to hardware is not exact. Empirical data suggest that Windows (using the Windows sleep timer which accepts millisecond sleep times) will schedule on a 1024 Hz clock and will delay 24 of 1024 transitions per second to make an average of 1000 Hz for the update rate.

We found this can have serious ramifications for discrete-time algorithms that rely on fairly consistent timing between updates such as those found in the control theory of the video game controllers. The sleep function or similar windows APIs were at no point designed for accurate timing purposes.

As a long term solution we proposed that more accurate timings could be achieved by using dedicated hardware extensions and control-loop cards by the game system vendors.

During the current year, as a short term solution we proposed that certain multimedia-oriented API routines like timeGetTime() and its siblings could be integrated to provide better timing consistency.

We experimented with over 30 API's in various configurations including (_____list key variables of experimentation).

Results:

- Average Response time: 0.6 seconds (82% of goal)
- Average memory use: 4000 bytes / query (110% of goal)
- Maximum number of concurrent users: 18000 users (70% of goal)

Experimentation indicated that both the consumer- and server-grade Windows (as of 2011 those based on NT kernel) were not capable of operating as real-time operating systems using this method.

Conclusion:

AN IDEAL CONCLUSION MIGHT IDENTIFY:

- FACTORS OR VARIABLES THAT CAUSED CERTAIN API'S TO PERFORM BETTER &
- TO CONSIDER IN OPTIMIZING WINDOWS OR OTHER ENVIRONMENTS.

Significant variables addressed: scheduling - queue sizes, levels, priorities

Activity #1-3: threads vs. processes-kernel vs.user level binding (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives

Example of potential experimentation:

User-level threads are unknown by the kernel, whereas the kernel is aware of kernel threads.

On systems using either M:1 or M:N mapping, user threads are scheduled by the thread library and the kernel schedules kernel threads.

Kernel threads need not be associated with a process whereas every user thread belongs to a process.

The main advantage of implementing threads in the kernel rather than in a user-mode library are that:
• kernel-threaded systems can take advantage of multiple processors if they are available &
• if one thread blocks in a kernel service routine (for example, a system call or page fault), other threads are still able to run.

Kernel threads are generally more expensive to maintain than user threads as they must be represented with a kernel data structure.

Because a thread is smaller than a process, thread creation typically uses fewer resources than process creation.

Creating a process requires allocating a process control block (PCB), a rather large data structure. The PCB includes a memory map, list of open files, and environment variables. Allocating and managing the memory map is typically the most time-consuming activity. Creating either a user or kernel thread involves allocating a small data structure to hold a register set, stack, and priority.

The hybrid approach, implementing multiple user threads over a smaller number of kernel threads, allows a balance between these tradeoffs to be achieved.

Eligible activities might include work aimed at understanding the methods to optimize these balance between these methods.

Results:

- Average Response time: 0.7 seconds (76% of goal)
- Average memory use: 8000 bytes / query (70% of goal)
- Maximum number of concurrent users: 13000 users (50% of goal)

The hybrid approach, implementing multiple user threads over a smaller number of kernel threads, allows a balance between these tradeoffs to be achieved.

Conclusion:

The hybrid approach, required the development of algorithms to classify each query as to whether it is better suited to:

- implement multiple user threads over
- a smaller number of kernel threads,

for optimal performance to be achieved.

Significant variables addressed: threads vs. processes-kernel vs.user level binding

Activity #1-4: scheduling - queue sizes, levels, priorities (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	1000 alternatives

Preemptive scheduling allows a process to be interrupted in the midst of its execution, taking the CPU away and allocating it to another process. Non-preemptive scheduling ensures that a process relinquishes control of the CPU only when it finishes with its current CPU burst.

Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best utilized for a particular file?
Answer:
• Contiguous—if file is usually accessed sequentially, if file is relatively small.
• Linked—if file is large and usually accessed sequentially.
• Indexed—if file is large and usually accessed randomly

In reality the developer will need to develop the parameters to define and implement this process.

Results:

- CPU usage: 45 % busy (62% of goal)

Conclusion:

An ideal conclusion might provide details as to WHY any of the following methods were more suited to this scenario:

- Scheduling: Preemptive vs. Nonpreemptive

- File allocation: contiguous vs. linked vs.& indexed

Significant variables addressed: scheduling - queue sizes, levels, priorities

Activity #1-5: locking methods - spinlock, muteses, conditions (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Process trials:	450 runs / samples

Solaris, Windows XP, and Linux implement multiple locking mechanisms depending on the application developers' needs.

Spinlocks are useful for multiprocessor systems where a thread can run in a busy-loop for a short period of time) rather than incurring the overhead of being put in a sleep queue.

Mutexes are useful for locking resources. Solaris 2 uses adaptive mutexes, meaning that the mutex is implemented with a spin lock on multiprocessor machines.

Semaphores and condition variables are more appropriate tools for synchronization when a resource must be held for a long period of time, since spinning is inefficient for a long duration.

Some schedules are possible under certain protocols. eg. the two-phase locking protocol but not possible under the timestamp protocol, and vice versa.

Results:

- Average Response time: 0.4 seconds (94% of goal)
- Stability (mean time between failures): 75000 # transactions (71% of goal)

Conclusion:

An ideal conclusion would provide further details as to:
- WHY a particular combination of locking methods /strategies
- was most appropriate in this particular scenario.

Significant variables addressed: locking methods - spinlock, muteses, conditions

Activity #1-6: User memory-virtual, mapped files, heaps, threads (Fiscal Year 2012)

Methods of experimentation:

Method	Experimentation Performed
Physical prototypes:	6 samples (with 600 revisions)

Some of the ways an application can use memory via the Win32 API.

1) Virtual memory provides several functions that allow an application to reserve and release memory, specifying the virtual address at which the memory is allocated.

2) A file may be memory mapped into address space, providing a means for two processes to share memory.

3) When a Win32 process is initialized, it is created with a default heap. Private heaps can be created that provide regions of Windows XP reserved address space for applications. Thread management functions are provided to allocate and control thread access to private heaps.

(4) A thread-local storage mechanism provides a way for global and static data to work properly in a multithreaded environment. Thread-lock storage allocates global storage on a per-thread basis.

Developers may experiment with using alternate methods in differing circumstances.

Results:

- Average Response time: 0.25 seconds (102% of goal)
- Average memory use: 7000 bytes / query (80% of goal)
- Maximum number of concurrent users: 22000 users (87% of goal)
- CPU usage: 34 % busy (90% of goal)

Conclusion:

An ideal conclusion would provide further details as to:

- WHY a particular type of combination of memory allocation methods /strategies
- was most appropriate in this particular scenario.

Significant variables addressed: User memory-virtual, mapped files, heaps, threads

Key Criteria Summary

R&D Base demo

1202 - Software - New Web techniques for animation & quasi-real time interactivity in browsers

Benchmarks:
Internet searches: 16 sites / articles
Competitive products or processes: 14 products
Similar prior in-house technologies: 3 products /
Potential components: 2 products
Queries to experts: 2 responses

Objectives:
Average Response time: 0.3 seconds
Data structures - number/complexity:
Average memory use: 5000 bytes / query
Maximum number of concurrent users: 25000 users
CPU usage: 30 % busy
Stability (mean time between failures): 100000 # transactions

Uncertainty: 1 - Technology constraints & related variables of experimentation

Key Variables: locking methods - spinlock, muteses, conditions, scheduling - queue sizes, levels, priorities, threads vs. processes-kernel vs.user level binding, User memory-virtual, mapped files, heaps, threads, Web services vs. Remoting / Flash- Flex vs. AJAX

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Web services vs. Remoting / Flash- Flex vs. AJAX	Process trials: 120 runs / samples	Average Response time: 1.8 seconds (11 %) Maximum number of concurrent users: 1500 users (2 %) Average memory use: 14000 bytes / query (10 %)	Web services vs. Remoting / Flash- Flex vs. AJAX	300.00	0.00	0.00	2012
2 - Prototype testing - latency issues MS Windows	Process trials: 300 runs / samples	Average Response time: 0.6 seconds (82 %) Average memory use: 4000 bytes / query (110 %) Maximum number of concurrent users: 18000 users (70 %)	scheduling - queue sizes, levels, priorities	200.00	0.00	0.00	2012
3 - threads vs. processes-kernel vs.user level binding	Analysis / simulation: 100 alternatives	Maximum number of concurrent users: 13000 users (50 %) Average memory use: 8000 bytes / query (70 %) Average Response time: 0.7 seconds (76 %)	threads vs. processes-kernel vs.user level binding	250.00	0.00	0.00	2012
4 - scheduling - queue sizes, levels, priorities	Analysis / simulation: 1000 alternatives	CPU usage: 45 % busy (62 %)	scheduling - queue sizes, levels, priorities	100.00	0.00	0.00	2012
5 - locking methods - spinlock, muteses, conditions	Process trials: 450 runs / samples	Stability (mean time between failures): 75000 # transactions (71 %) Average Response time: 0.4 seconds (94 %)	locking methods - spinlock, muteses, conditions	120.00	0.00	0.00	2012
6 - User memory-virtual, mapped files, heaps, threads	Physical prototypes: 6 samples ... prototype revisions: 600 revisions	Average Response time: 0.25 seconds (102 %) Average memory use: 7000 bytes / query (80 %) Maximum number of concurrent users: 22000 users (87 %) CPU usage: 34 % busy (90 %)	User memory-virtual, mapped files, heaps, threads	160.00	0.00	0.00	2012

New CRA pronouncements

2013 YMPE set at $51,100

The Yearly Maximum Pensionable Earnings amount for 2013 has been set at $51,100.

This has the following limits on the SR&ED wages and proxy overhead allocations for "specified employees as follows:

New Form T661 to reflect 2013 changes

A new form is required after Dec 31, 2012 & includes the following changes from the 2012 budget to reduce:

- SR&ED contract expenditures by 20% &
- Proxy amount to 60%

SR&ED Salary & Wage inclusions

		Specified employees*	Non-specified employee	ITA section
1	**R&D labour for the:**			
a)	R&D expenditure pool (for deduction), **&**			37(1)
b)	Qualified expenses (for ITC calculation)			127(9)
	Type of expense:			
	· salary & wages	**In**	**In**	(5-8)
	· bonuses or profit based remuneration	**Out**	**In**	37(9) & 5(1)
	· Expenses paid > 180 days	**Out**	**Out**	78(4)
	Maximum	**5 x [YMPE]**	**N/A**	37(9.1)
2	**Salary base for proxy amount (for ITC calculation)**			
	Type of expense:			
	· Income from employment	**In**	**In**	5
	· bonuses/profit based remuneration	**Out**	**Out**	5(1) & 37(9)
		Out	**Out**	6 & 7
	· Expenses paid > 180 days	**Out**	**Out**	78(4)
	Maximum	**2.5x [YMPE]**	**N/A**	Reg. 2900(7)

SR&ED wages - annual limits

	SR&ED labour:	YMPE		Specified employees*	Non-specified
1	2011	$ 48,300	$	241,500	No limit
	2012	$ 50,100	$	250,500	No limit
	2013	**$ 51,100**	**$**	**255,500**	**No limit**
2	**Salary base for proxy amount**				
	2011	$ 48,300	$	120,750	No limit
	2012	$ 50,100	$	125,250	No limit
	2013	**$ 51,100**	**$**	**127,750**	**No limit**

***Specified employees own >=10% any class of stock (or related to such shareholders).**

Questions or feedback

We welcome your questions or feedback on any issues raised in this letter.

We also encourage interested parties to examine:

- past SR&ED newsletters
- SR&ED tax guide [the Guide to RDBASE.NET],
- "RDBASE.NET" online SR&ED tracking software &
- additional tutorials re. eligible SR&ED activities at

www.rdbase.net

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Before implementing decisions based on this information, readers are encouraged to seek professional advice, in order to clarify how any issues discussed herein, may relate to their specific situations.

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