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

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

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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.

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[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.

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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