Machinery Industry

The following guidelines are intended to provide examples of "experimental development" projects which would qualify for Canadian SR&ED (Scientific Research & Experimental Development) tax credits.

1001 - Improve Compounding Equipment:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective
Temperature variance (Deg C)	5	2
Output (output/minute)	100	120
Shear (tons/sq.inch)	10	12
Improve Dispersivity (mm)	0.5	1
Max cost increase (%)	0	15

[AUTHOR'S NOTE: THIS DESCRIPTION IS BASED ON THE CRA'S INFORMATION CIRCULAR 94-1: PLASTICS INDUSTRY APPLICATION PAPER, NEW EQUIPMENT, EXAMPLE 2]

[AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD ATTEMPT TO QUANTIFY THE OBJECTIVES THEY ARE TRYING TO ACHIEVE. QUANTIFIABLE OBJECTIVES HAVE BEEN ADDED ABOVE, TO ILLUSTRATE.]

This project offers an example of modifying older equipment (the Gelimat) to produce a unique form of compounding equipment with advantages such as:
-high output rates,
-high dispersivity,
-absence of shear,
-ease of cleaning as changes are made from one compound to another, and
-low capital cost relative to conventional systems.

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

- Internet searches: 33 sites / articles -- Identified 18 articles on mix variation effects on temperature + limits of thermocouples
- Patent searches: 2 patents -- 2 method to use thermocouples for control process - neither applicable our environment
- Potential components: 14 products -- 14 products from 4 different thermocouple suppliers and differences in performance
- Queries to experts: 2 responses -- Spoke with 2 machine designers to identify alternate control methods. Limitations wrt temp variance.

[AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD OUTLINE THE CURRENT INDUSTRY STANDARD PRACTICE, AND ATTEMPT TO IDENTIFY THE SPECIFIC METHODS OR VARIABLES WHICH CREATE THE PERCEIVED LIMITATIONS WITH RESPECT TO OBTAINING THE STATED OBJECTIVE(S). EXAMPLE BENCHMARKS HAVE BEEN PROVIDED ABOVE, TO ILLUSTRATE.]

Field of Science/Technology:

Mechanical engineering (2.03.01)

Intended Results:

- Improve existing materials, devices, or products

Work locations:

Lab, Commercial Facility

Scientific or Technological Advancement:

Uncertainty #1: Temperature control

Although mechanical development such as changes in the angles of the rotating blades and increased speed permitting timely fluxing of most plastics without any external application of heat, uncertainty remained as to practical ways to sense and control the temperature. A fraction of a second too long near the fluxing point could lead to a increase of over 50 C, and hence the potentially catastrophic degradation of plastics such as P.V.C.

The most significant underlying key variables are:
angle, speed, temperature, sensitivity, time

Activity #1-1: Thermocouples

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 12 alternatives - Examined 12 alternate configurations of Thermocouples & vibration techniques
- Process trials: 36 runs / samples - Performed 3 runs at differing pressures for each of the 12 alternate configurations

  [AUTHOR'S NOTE: THE DESCRIPTIONS PROVIDED IN THE CRA'S EXAMPLE DID NOT INCLUDE SUFFICIENT DETAILS ABOUT TESTING PERFORMED. THE DATA ABOVE (# TRIALS/ALTERNATIVES) IS PROVIDED TO ILLUSTRATE SOME OF THE ADDITIONAL DETAILS THAT WOULD IDEALLY BE INCLUDED.]

Results:

- Temperature variance: 4 Deg C (33% of objective)
- Output: 100 output/minute (no improvement)
- Shear: 11 tons/sq.inch (50% of objective)
- Improve Dispersivity: 0.6 mm (20% of objective)

Conclusion:

Attempts at control by techniques such as by vibration and by thermocouples proved inadequate.

[AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD ATTEMPT TO QUANTIFY SOME OF THE INTER-RELATIONS WHICH WERE OBSERVED AND ANY RELATED TECHNICAL CONCLUSIONS TO EXPLAIN THESE RESULTS.]

Key variables resolved: angle, sensitivity, speed, temperature, time

Activity #1-2: Fibre Optics

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 1 alternatives - Identified a potential system using fibre optics
- Process trials: 5 runs / samples - Performed 5 runs at differing pressures

  [AUTHOR'S NOTE: THE DESCRIPTIONS BELOW WERE PROVIDED IN THE CRA'S EXAMPLE. THE DATA ABOVE (# TRIALS/ALTERNATIVES) IS PROVIDED TO ILLUSTRATE SOME OF THE ADDITIONAL DETAILS THAT WOULD IDEALLY BE INCLUDED.]

  Eventually, the development of a (patented) glass fibre-optics temperature-control system based upon sensing at millisecond. Intervals of the infrared radiation given off by the material as it was heated permitted the fine temperature control (+/- 2 C) to process even P.V.C. to within a few degrees of its degradation temperature.

  [AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD FURTHER ATTEMPT TO ILLUSTRATE A "HYPOTHESIS, DESIGN, TEST, & MODIFY" CYCLE RELATED TO THE ABOVE EXPERIMENTATION.]

Results:

- Temperature variance: 1 Deg C (133% of objective) -- tolerance proved achievable only via fibre optic system
- Output: 112 output/minute (60% of objective)
- Shear: 13 tons/sq.inch (150% of objective)
- Improve Dispersivity: 0.9 mm (80% of objective)
- Max cost increase: 20 % (133% of objective)

Conclusion:

This new mixing technology proved successful for the compounding of P.V.C. and other shear-sensitive and/or temperature-sensitive plastics.
[NOTE: AN IDEAL TECHNICAL DESCRIPTION WOULD INCLUDE A CONCLUSION DISCUSSING WHAT WAS LEARNED FROM THE EXPERIMENTATION AND RELATE IT TO THE UNCERTAINTY.]

Key variables resolved: angle, sensitivity, speed, temperature, time

Technical Documents:

- TECHNICAL DOCUMENTATION RETAINED

1001 - Improve Compounding Equipment

Benchmarks:
Internet searches: 33 sites / articles
Patent searches: 2 patents
Potential components: 14 products
Queries to experts: 2 responses

Objectives:
Temperature variance: 2 Deg C
Output: 120 output/minute
Shear: 12 tons/sq.inch
Improve Dispersivity: 1 mm
Max cost increase: 15 %

Uncertainty: 1 - Temperature control

Key Variables: angle, sensitivity, speed, temperature, time

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Thermocouples	Analysis / simulation: 12 alternatives Process trials: 36 runs / samples	Temperature variance: 4 Deg C (33 %) Output: 100 output/minute (0 %) Improve Dispersivity: 0.6 mm (20 %) Shear: 11 tons/sq.inch (50 %)	angle sensitivity speed temperature time	0.00	0.00	0.00	2010
2 - Fibre Optics	Analysis / simulation: 1 alternatives Process trials: 5 runs / samples	Temperature variance: 1 Deg C (133 %) Output: 112 output/minute (60 %) Shear: 13 tons/sq.inch (150 %) Improve Dispersivity: 0.9 mm (80 %) Max cost increase: 20 % (133 %)	angle sensitivity speed temperature time	0.00	0.00	0.00	2010

1002 - New material for existing product design:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective
Maximum Cost of moulded parts ($/part)	0.06	0.04
Maximum cost of Mould ($)	55000	59000
Maximum cost of material ($ per batch)	250	275
Increase production speed (cycles per hour)	2.3	4

[AUTHOR'S NOTE: THIS PROJECT DESCRIPTION IS BASED ON THE CANADA REVENUE AGENCY'S (CRA) EXAMPLE OF AN ELIGIBLE PROJECT FROM THEIR PLASTICS INDUSTRY SR&ED APPLICATION PAPER (INFORMATION CIRCULAR 94-1)]

[AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD ATTEMPT TO QUANTIFY THE OBJECTIVES THEY ARE TRYING TO ACHIEVE. A QUANTIFIABLE OBJECTIVE HAS BEEN ADDED ABOVE, TO ILLUSTRATE.]

Bob works with an injection moulder and wants to develop a less costly material for making a part currently moulded from nylon 6,6.

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

- Internet searches: 17 sites / articles -- Insufficient info
- Patent searches: 4 patents -- Formulations work with different processes.
- Similar prior in-house technologies: 1 products / processes -- Want to use existing injection mould, but it was designed for use with nylon.
- Queries to experts: 3 responses -- No info on alternate materials obtained

Field of Science/Technology:

Materials engineering & metallurgy (2.05.01)

Intended Results:

- Improve existing processes
- Improve existing materials, devices, or products

Work locations:

Commercial Facility

Scientific or Technological Advancement:

Uncertainty #1: Departures from standard practice

We are uncertain whether changes in viscosity and rheology resulting from the presence of fibres would permit the use of the existing mould. There was no known flow modeling software capable of predicting the performance or flow characteristics of the proposed material.

[NOTE: IT IS BEST TO PHRASE THE "UNCERTAINTIES" AT THE HIGHEST TECHNICAL LEVELS POSSIBLE AND ILLUSTRATE THE UNDERLYING PROBLEMS THROUGH SECTION III BELOW: I.E. INVESTIGATIVE "ACTIVITIES" AND RELATED CONCLUSIONS.]

The most significant underlying key variables are:
viscosity, rheology, molecular weight, amount and type of fibres, material formulation

Activity #1-1: Testing

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 1 alternatives - Model developed - correlation of nylon vs. polypropylene flow variables.
- Physical prototypes: 41 samples - Polypropylene samples used to develop model, as outlined below.

[NOTE: CORRELATE RESEARCH STEPS TO THE UNCERTAINTIES IN QUESTION. IDEALLY WE CAN PROVIDE ABILITY TO DISPLAY CROSS-REFERENCES TO SUPPORTING TECHNICAL DOCUMENTATION INCLUDING LAB NOTES, DRAWINGS, RESEARCH PAPERS AND OTHER CORPORATE PAPERS OF TECHNICAL RELEVANCE.]

-We prepared samples of glass-fiber reinforced polypropylene of various compositions and fiber content and attempts to injection mould parts. This involved examination of 34 polypropylene samples: notes, preliminary hypotheses, & related test results (48 pages) - June 11- August 5

-These were used as a base to define the spectrum of expected viscosity & relays parameters under differing fiber levels, temperatures and pressures. Technical meeting notes (18 pages) - August 15-18

-The prototypes were then tested against the anticipated performance parameters. These tests involved the correlation of nylon vs. polypropylene flow variables & concluded that the desired mould could be formed - August 18-28 (22 pages)

-The prototype results were then combined with results from the additional industry models above. The resultant model was then developed involving the correlation of nylon vs. polypropylene flow variables & related conclusions regarding inter-relations of viscosity & rheology on mould parameters - August 30 (12 pages including seven prototype models subsequently revised)

For each research step we should briefly provide allocations or reasonable estimates for each of the following:

-Labor hours / employee
-Costs of any subcontracting, Universities or other third parties + brief explanation of their involvement
-Materials used in prototypes or experimental production + clarify if the prototypes were sold

[NOTE: THESE DETAILS CAN BE PROVIDED FROM YOUR ACCOUNTING SYSTEM (IF YOU USE JOB COSTING SYSTEM) OR AS SEPARATE SUMMARIES OTHERWISE. THE CRA ALSO REQUIRES THAT AT LEAST 90% OF THE WORK MUST BE PHYSICALLY PERFORMED IN CANADA. SUBCONTRACTORS MUST BE CANADIAN.]

Results:

- Maximum Cost of moulded parts: 0.04 $/part (100% of objective)
- Maximum cost of Mould: 60000 $ (125% of objective)
- Maximum cost of material: 271 $ per batch (84% of objective)
- Increase production speed: 3.8 cycles per hour (88% of objective)

Conclusion:

We determined that a polypropylene of a specific molecular weight and at defined levels of glass-fibre filling can indeed be successfully moulded, and that it can match the properties of the part previously made from nylon.

We refined our predictive models for injection moulding to include polypropylene of certain restricted glass fibre contents.

[IDEALLY THE DESCRIPTION WOULD PROVIDE FURTHER EVIDENCE OF RESULTS OR CONCLUSIONS THAT WERE UNEXPECTED AT THE OUTSET OF THE WORK.]

Key variables resolved: amount and type of fibres, material formulation, molecular weight, rheology, viscosity

1002 - New material for existing product design

Benchmarks: Internet searches: 17 sites / articles
Patent searches: 4 patents
Similar prior in-house technologies: 1 products /
Queries to experts: 3 responses

Objectives: Maximum Cost of moulded parts: 0.04 $/part
Maximum cost of Mould: 59000 $
Maximum cost of material: 275 $ per batch
Increase production speed: 4 cycles per hour

Uncertainty: 1 - Departures from standard practice

Key Variables: amount and type of fibres, material formulation, molecular weight, rheology, viscosity

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Testing	Analysis / simulation: 1 alternatives Physical prototypes: 41 samples	Maximum Cost of moulded parts: 0.04 $/part (100 %) Maximum cost of Mould: 60000 $ (125 %) Maximum cost of material: 271 $ per batch (84 %) Increase production speed: 3.8 cycles per hour (88 %)	amount and type of fibres material formulation molecular weight rheology viscosity	0.00	0.00	0.00	2010

1003 - Furnace process for new catalyst:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective
Pore size variation (angstroms)	10	2
Improve production speed (L per hour)	298	525
Cost of production ($ per L)	5.25	5.5
maximize consistency (+ or - (%))	2.5	1.5

[AUTHOR'S NOTE: THIS PROJECT DESCRIPTION IS BASED ON THE CANADA REVENUE AGENCY'S (CRA) EXAMPLE OF AN ELIGIBLE PROJECT FROM THEIR CROSS-SECTOR SHOP FLOOR GUIDANCE DOCUMENT (JULY 29, 2002).]

[AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD ATTEMPT TO QUANTIFY THE OBJECTIVES THEY ARE TRYING TO ACHIEVE. A QUANTIFIABLE OBJECTIVE HAS BEEN ADDED ABOVE, TO ILLUSTRATE.]

The objective was to develop the process to manufacture a new catalyst for the client's commercial emission control system. The design was different than any previous catalysts produced.

The challenge was to maintain consistent pore size with the new catalyst geometry. This required the company to determine the effects of furnace temperature profiling on pore dimensions in the catalyst. If successful, this would also enable the company to expand their capabilities in terms of the geometry of products they could produce.

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

- Internet searches: 7 sites / articles -- No information on different configuration than manufactured in the past.
- Patent searches: 5 patents -- No info relating to issues.
- Similar prior in-house technologies: 1 products / processes -- Initial bench scale development completed previously. Still need to deal with manufacturing issues.
- Queries to experts: 3 responses -- Did not reveal any new info

The company manufactures catalysts for commercial emission control systems. The process involves the use of high cost specialized metals. The company is starting a new product with a different configuration than manufactured in the past. The initial bench scale development had been completed previously at another facility. This claim relates only to the manufacturing component of the project. All firings are done in furnaces with 1800 unit capacities. The company is constrained by the need to maintain consistent pore size in the finished product and must use their existing facilities.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Intended Results:

- Develop new materials, devices, or products
- Improve existing processes

Work locations:

Commercial Facility

Scientific or Technological Advancement:

Uncertainty #1: Firing parameters

[IT IS BEST TO PHRASE THE UNCERTAINTIES AT THE HIGHEST TECHNICAL LEVELS POSSIBLE AND ILLUSTRATE THE UNDERLYING PROBLEMS THROUGH THE ACTIVITIES.]

Using existing facilities, it was uncertain as to what firing parameters affected pore size distribution and cracking of the product. Once determined, it was also uncertain as to how to manipulate and control these factors to achieve uniform results and eliminate cracking problems.

The most significant underlying key variables are:
firing parameters, pore size distribution, cracking, furnace temperature

Activity #1-1: Pore size testing

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 1 alternatives - Model developed based on results of below tests.
- Process trials: 15 runs / samples - 4 initial runs to determine critical factors, followed by 11 batches with detailed analysis to form model.

[CORRELATE RESEARCH STEPS OR ACTIVITIES TO THE UNCERTAINTIES IN QUESTION. IDEALLY, WE CAN PROVIDE ABILITY TO DISPLAY CROSS-REFERENCES TO SUPPORTING TECHNICAL DOCUMENTATION INCLUDING LAB NOTES, DRAWINGS, RESEARCH PAPERS AND OTHER CORPORATE PAPERS OF TECHNICAL RELEVANCE].

The following work was performed in this project this fiscal year:
- Initial commercial-scale runs showed inconsistent pore size and cracking
- Subsequent tests run to determine critical factors causing cracking and uneven pore sizes
- Numerous (eleven different) batches were run with detailed analyses which determined the location of faulty product within the furnace
- Furnace operating parameters including steady state temperature, heating and cooling times were varied.
- Relationships between the cracking incidence, pore size distribution and firing parameters were developed
- Output was a detailed thermo-profiling of the furnace and a computer model for predicting cracking and pore distortion
- This model and the knowledge gained was then implemented in similar product lines and resulted in measurable scrap rate reduction for production

For each research step we should briefly provide allocations or reasonable estimates for each of the following:

-Labour hours / employee
-Costs of any subcontractors, Universities or other third parties + brief explanation of their involvement
-Materials used in prototypes or experimental production + clarify if the prototypes were sold

[NOTE: THESE DETAILS CAN BE PROVIDED FROM YOUR ACCOUNTING SYSTEM (IF YOU USE JOB COSTING SYSTEM) OR AS SEPARATE SUMMARIES. THE CRA ALSO REQUIRES THAT ALL WORK MUST BE PHYSICALLY PERFORMED IN CANADA.]

Results:

- Pore size variation: 1 angstroms (112% of objective)
- Improve production speed: 475 L per hour (77% of objective)
- Cost of production: 5.5 $ per L (100% of objective)
- maximize consistency: 1.6 + or - (%) (90% of objective)

Conclusion:

We determined the effects of furnace temperature profiling on pore dimensions in the catalyst, which enabled the company to expand their capabilities in terms of the geometry of products they could produce.

[AUTHOR'S NOTE: BASED ON THE SCOPE OF THIS PROJECT, THE PROJECT DESCRIPTION PROVIDED WAS APPROPRIATE AND ACCEPTABLE TO CRA AS A COMPLETE CLAIM. IDEALLY, AN OPTIMAL DESCRIPTION WOULD PROVIDE FURTHER EVIDENCE OF RESULTS OR CONCLUSIONS, WHICH WERE UNEXPECTED AT THE OUTSET OF THE WORK.]

Key variables resolved: cracking, firing parameters, furnace temperature, pore size distribution

1003 - Furnace process for new catalyst

Benchmarks:
Internet searches: 7 sites / articles
Patent searches: 5 patents
Similar prior in-house technologies: 1 products /
Queries to experts: 3 responses

Objectives:
Pore size variation: 2 angstroms
Improve production speed: 525 L per hour
Cost of production: 5.5 $ per L
maximize consistency: 1.5 + or - (%)

Uncertainty: 1 - Firing parameters

Key Variables: cracking, firing parameters, furnace temperature, pore size distribution

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Pore size testing	Analysis / simulation: 1 alternatives Process trials: 15 runs / samples	Pore size variation: 1 angstroms (112 %) Improve production speed: 475 L per hour (77 %) Cost of production: 5.5 $ per L (100 %) maximize consistency: 1.6 + or - (%) (90 %)	cracking firing parameters furnace temperature pore size distribution	0.00	0.00	0.00	2010

1004 - Electric Drive System:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective
Minimize machine footprint (m)	2	1
productivity and output (pieces per hour)	15	35
Maximum cost of machine ($ per unit)	55000	60000
Minimize maintenance and down time (Hours per week)	10	2

[AUTHOR'S NOTE: THIS PROJECT DESCRIPTION IS BASED ON THE CRA'S EXAMPLE OF A PARTIALLY ELIGIBLE PROJECT FROM THEIR "SR&ED MACHINERY APPLICATION PAPER," INFORMATION CIRCULAR 94-2]

[AUTHOR'S NOTE: IDEALLY THE TAXPAYER WOULD ATTEMPT TO QUANTIFY THE OBJECTIVES THEY ARE TRYING TO ACHIEVE. A QUANTIFIABLE OBJECTIVE HAS BEEN ADDED ABOVE, TO ILLUSTRATE.]

The objective is to build a machine that uses electric motors and servos rather than hydraulic power to reduce the mechanical complexity and the size of the machine, as well as to enhance the throughput of the machine.

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

- Internet searches: 17 sites / articles -- 5 articles on various control methods
- Patent searches: 6 patents -- different environment
- Similar prior in-house technologies: 1 products / processes -- New specifications could not be met using company's current hydraulic technology.
- Potential components: 6 products -- Electrical drive systems
- Queries to experts: 2 responses -- No info obtained on relative conversion issues

The company identified an opportunity with one of its customers to develop a product with enhanced capabilities (e.g., productivity and output in pieces per hour). The customer agreed to purchase a machine that met its specifications at a fixed price. Preliminary examination indicated that these new specifications could not be met using the company's current hydraulic technology however, we believed that the new specifications might be met if we replaced the hydraulic drive with an electric one.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Intended Results:

- Improve existing processes
- Improve existing materials, devices, or products

Work locations:

Analysis, Commercial Facility, on-site

Scientific or Technological Advancement:

Uncertainty #1: Hydraulic System Limits

To what extent will existing hydraulic systems enable the machine to meet its desired performance specifications? What models/methods might be used as an alternative to current hydraulic systems should they prove inadequate?

The most significant underlying key variables are:
Types of drives, Operating pressures, Working performance, Hydraulic Component selection

Activity #1-1: Existing Product Analysis

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 4 alternatives - Researched & conducted simple testing of existing hydraulic systems in relation to the technical capability requirements of the machine.

Results:

[NOTE: IF THERE WERE ANY TEST RESULTS FROM THIS ACTIVITY THAN THESE SHOULD BE STATED HERE]

Conclusion:

The machine's enhanced technical requirements cannot be achieved using a hydraulic system.

Key variables resolved: Types of drives, Working performance

Activity #1-2: Analysis of Alternatives

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 3 alternatives - Conducted a feasibility study aimed at identifying alternative models/methods worth pursuing.

  [AUTHOR'S NOTE: IDEALLY CLAIMANTS WOULD PROVIDE SPECIFIC DETAILS AS TO SOME OF THE MOST SIGNIFICANT VARIABLES EXAMINED.]

Results:

[NOTE: SIMILARLY, IF THERE WERE ANY TEST RESULTS FROM THIS ACTIVITY THAN THESE SHOULD BE STATED HERE]

Conclusion:

Determined that an electric drive system combined with an electronic control system might enable the machine to perform at our desired level.

[AUTHOR'S NOTE: THE IDEAL CONCLUSION WOULD COMPARE RESULTS WITH INITIAL EXPECTATIONS AND TRY TO PROVIDE TECHNICAL EXPLANATIONS FOR THESE DIFFERENCES.]

Key variables resolved: Hydraulic Component selection, Operating pressures, Types of drives, Working performance

Uncertainty #2: Space

The new drive system must have dimensions of not more than 2m long by 1m wide by 0.5m high.

The most significant underlying key variables are:
height, Width, Length, weight

Activity #2-1: Design Iterations

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 5 alternatives - Design iterations made based on results of the mock-up experiments and the recommendations of the electrical engineer.

  The frame itself had to be widened by 10cm over the 1m width goal or the servos had to be repositioned.

  [AUTHOR'S NOTE: IDEALLY, CLAIMANTS WOULD PROVIDE SPECIFIC DETAILS AS TO SOME OF THE MOST SIGNIFICANT VARIABLES EXAMINED. IN ADDITION TO A BRIEF OVERVIEW OF THE WORK PERFORMED, [EACH ACTIVITY] SHOULD ATTEMPT TO CROSS-REFERENCE RELEVANT, TECHNICAL DOCUMENTATION INCLUDING: DOCUMENT NAME, DATE, # OF PAGES AND LOCATION.]

Results:

- Minimize machine footprint: 1.1 m (90% of objective)

Conclusion:

The physical size constraint was achievable if ....

[AUTHOR'S NOTE - THE IDEAL SOLUTION WOULD PROVIDE DETAIL OF THE VARIABLES IN QUESTIONS AND HOW RESULTS VARIED FROM INITIAL EXPECTATIONS.]

Key variables resolved: height, Length, weight, Width

Uncertainty #3: Control Optimization

Drive system must have sufficient control to achieve the mechanical tolerance desired in the pressing.

The most significant underlying key variables are:
mechanical tolerance, Backlash, Type of drive, Type of control method

Activity #3-1: Mechanical Tolerance

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Process trials: 6 runs / samples - Experiments were performed to simulate the fine control required to achieve the mechanical tolerance on the work piece.

  These experiments revealed that combinations of electrical noise from the servos and lack of rigidity in the frame required a re-arrangement of motor and frame layout.

Conclusion:

Identified 2 voltage & wave form combinations that would cause electrical spikes within the system. Several modifications to the PLC design would have to be made in order to achieve the required results.

Key variables resolved: Backlash, mechanical tolerance, Type of drive

Activity #3-2: PLC Design Modifications

Work performed in Fiscal Year 2010:

Methods of experimentation:

- ... prototype revisions: 4 revisions - 4 major series of modifications were made to the PLC design and parameter settings to accommodate changes in frame and servo layouts.

Conclusion:

The required results were achieved.

[AUTHOR'S NOTE: THE IDEAL CONCLUSION WOULD COMPARE RESULTS WITH INITIAL EXPECTATIONS AND TRY TO PROVIDE TECHNICAL EXPLANATIONS FOR THESE DIFFERENCES.]

Key variables resolved: mechanical tolerance, Type of control method, Type of drive

Uncertainty #4: Motor Selection

The optimal motor based on the force requirement for pressing the work piece, the speed of the drive system, and the physical size constraint must be identified.

The most significant underlying key variables are:
force, speed, size, weight, Type

Activity #4-1: Performance Analysis

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Analysis / simulation: 1 alternatives - The electrical engineer consultant conducted an analysis of the motor's performance requirements and summarized his findings.

Conclusion:

3 motors, each with a different speed-torque characteristic, were recommended. Each would have to be tested to determine which one would produce optimal results.

Key variables resolved: force, size, speed

Activity #4-2: Scaled Down Model Tests

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Process trials: 216 runs / samples - 36 tests for each of 6 motor/voltage configurations.

  Tested 3 different GE ECM motors @ two different voltages on a scaled down model of the drive system coupled to the prototype logic system to map and determine constants for programming motors. 36 tests comprising of 9-18 data points each were run for analysis.

Conclusion:

The tests seemed to indicate that the motor that had a mid-range speed-torque characteristic should be the one selected for the final system. However, this could only be confirmed by building and testing the actual system.

[AUTHOR'S NOTE: THE IDEAL CONCLUSION WOULD COMPARE RESULTS WITH INITIAL EXPECTATIONS.]

Key variables resolved: force, speed, Type, weight

Activity #4-3: On-Site Testing

Work performed in Fiscal Year 2010:

Methods of experimentation:

- Process trials: 1 runs / samples - On-site testing.
  The new electric drive system using the selected motor and the new control system was constructed, assembled, retrofitted to an existing hydraulic model, and installed at the customer's site and tested to meet the technological specifications.

Results:

- Minimize machine footprint: 1 m (100% of objective)
- productivity and output : 40 pieces per hour (125% of objective)
- Maximum cost of machine: 61000 $ per unit (120% of objective)
- Minimize maintenance and down time: 3 Hours per week (87% of objective)

Conclusion:

This confirmed that a motor with a mid-range speed-torque characteristic enables the machine, after some adjustments, to meet its technological requirements. Several modifications to the installed model would be required to meet the model's technological requirements.

Key variables resolved: force, size, speed

Uncertainty #5: Non-SR&ED issues

The CRA provides examples of remaining project activities which are NOT ELIGIBLE FOR SR&ED TAX CREDITS since they were not required to remove any of the stated technological uncertainties.

Activity #5-1: Ineligible activities

Work performed in Fiscal Year 2010:

Methods of experimentation:

According to the CRA, the following activities do not fall within the "envelope of SR&ED" and cannot be claimed:

The activities relating to the interface between the new drive and the existing components (did not involve any technological uncertainty, and, therefore, fall outside the "envelope of SR&ED.")

Construction and assembly of new electronic control system, both time and materials (related to commercial activity - as above);

Acoustic damping work during testing at customer's site, both time and materials (standard practice not related to resolving technological uncertainty);

Control system modification to make it simpler to use, both time and material (standard practice not related to resolving technological uncertainty; not required to achieve technological objectives, but required to satisfy customer's need;

Work related to replacing relays and installing line filters during testing at customer's site, both time and materials (trouble-shooting and debugging not related to resolving technological uncertainty);

Work related to investigating intermittent operation due to dust, and installing dust covers during test at customer's site, both time and material (trouble-shooting and debugging not related to resolving technological uncertainty).

Conclusion:

THOSE ACTIVITIES WHICH ARE NOT NECESSARY TO RESOLVE THE STATED TECHNOLOGICAL UNCERTAINTIES ARE INELIGIBLE FOR SR&ED TAX CREDITS!

Activity #5-2: Ineligible Activities revisited - what if?

Work performed in Fiscal Year 2010:

Methods of experimentation:

The CRA then provides a second example: Assume the same facts as those described in the first example. However, in this case, there was uncertainty about whether integrating the new electrical drive system into the current machine structure could be achieved without major modifications to the machine structure.

In carrying out the integration, it was learned that major modifications had to be made to the current machine structure before the integration would meet technological specifications. These modifications required both new construction materials and significant changes to the basic design and interface of standard components. In this example, system uncertainty exists about whether integrating standard components to the new electric drive can be achieved without major modifications while still meeting the required technological specifications.

Although the operation of individual components may have been known, the result of the interactions among them as a whole was unknown, and could only be resolved through a project that incorporated a systematic investigation to determine the result of the interactions. Therefore, the SR&ED project WOULD INCLUDE those activities identified in the first example, as well as all those activities related to modifying all related components.

.Conclusion:

TO THE EXTENT THAT ACTIVITIES ARE NECESSARY TO RESOLVE THE STATED TECHNOLOGICAL UNCERTAINTIES, THEY ARE ELIGIBLE FOR SR&ED TAX CREDITS!

Project Name: Electric Drive System
Project Number: 1004
Start Date: 2010-01-01
Completion Date: 2010-12-31

1004 - Electric Drive System

Benchmarks:
Internet searches: 17 sites / articles
Patent searches: 6 patents
Similar prior in-house technologies: 1 products /
Potential components: 6 products
Queries to experts: 2 responses

Objectives:
Minimize machine footprint: 1 m
productivity and output : 35 pieces per hour
Maximum cost of machine: 60000 $ per unit
Minimize maintenance and down time: 2 Hours per week

Uncertainty: 1 - Hydraulic System Limits
Key Variables: Hydraulic Component selection, Operating pressures, Types of drives, Working performance

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Existing Product Analysis	Analysis / simulation: 4 alternatives	(none)	Types of drives Working performance	0.00	0.00	0.00	2010
2 - Analysis of Alternatives	Analysis / simulation: 3 alternatives	(none)	Hydraulic Component selection Operating pressures Types of drives Working performance	0.00	0.00	0.00	2010

Uncertainty: 2 - Space
Key Variables: height, Length, weight, Width

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Design Iterations	Analysis / simulation: 5 alternatives	Minimize machine footprint: 1.1 m (90 %)	height Length weight Width	0.00	0.00	0.00	2010

Uncertainty: 3 - Control Optimization
Key Variables: Backlash, mechanical tolerance, Type of control method, Type of drive

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Mechanical Tolerance	Process trials: 6 runs / samples	(none)	Backlash mechanical tolerance Type of drive	0.00	0.00	0.00	2010
2 - PLC Design Modifications	... prototype revisions: 4 revisions	(none)	mechanical tolerance Type of control method Type of drive	0.00	0.00	0.00	2010

Uncertainty: 4 - Motor Selection
Key Variables: force, size, speed, Type, weight

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Performance Analysis	Analysis / simulation: 1 alternatives	(none)	force size speed	0.00	0.00	0.00	2010
2 - Scaled Down Model Tests	Process trials: 216 runs / samples	(none)	force speed Type weight	0.00	0.00	0.00	2010
3 - On-Site Testing	Process trials: 1 runs / samples	Minimize machine footprint: 1 m (100 %) productivity and output : 40 pieces per hour (125 %) Maximum cost of machine: 61000 $ per unit (120 %) Minimize maintenance and down time: 3 Hours per week (87 %)	force speed size	0.00	0.00	0.00	2010

Uncertainty: 5 - Non-SR&ED issues
Key Variables: (none)

Activity	Testing Methods	Results - % of Objective	Variables Concluded	Hours	Materials $	Subcontractor $	Fiscal Year
1 - Ineligible activities	(none)	(none)	(none)	0.00	0.00	0.00	2010
2 - Ineligible Activities revisited - what if?	(none)	(none)	(none)	0.00	0.00	0.00	2010