

NSERC Chair in Design for Aluminium

Report on 1st term

Period covered: January 1st 2011 to December 31st 2015

By Alain Desrochers, Chairholder

Summary of Chair achievements / what to remember

The Chair mandate is twofold; one targeted at design from prototype to product and the other to the use of aluminium in products. The achievements listed below point to one or the other.

- a) *Increase in the number of industrial projects offered at the undergraduate and graduate levels:* Industry-driven undergraduate projects have increased in proportion from 36% on average in 2011 and 2012 to 65% on average in 2013 and 2014 with a cumulative total budget over 1,27M\$ for the four years and 60% of the projects making use of aluminum in addition to a significant number of new projects (26) offered at the graduate level;
- b) *Introduction of multidisciplinary projects centred on electric vehicles:* At the undergraduate level, the Association of Electric Transportation at Université de Sherbrooke (ATEUS) established in 2012 oversees 517K\$ for 130 students while the Automotive Partnership Canada (APC) provided an 11,4M\$ grant to develop an electric roadster with 22 graduate HQP and 12 professors along the way.
- c) *Promotion targeting aluminium training and use in products:* The Chair partners, other than NSERC, are all from the aluminium industry and are very much concerned by the Chair visibility, therefore explaining the many conferences and interviews related to aluminium, the Canada Games aluminium cauldron, the involvement in the definition of a provincial strategy toward aluminium, etc...
- d) *Actions to support prototyping toward products:* This is the Chair contribution to the knowledge and know-how of students to help them build prototypes that get as close as possible to products ready to market. To that end, webinars and a course on structural lightening for vehicles were prepared along with laboratories, free aluminium and an assembly workshop complete with water-cutting machine, welding, riveting machine, etc.

Other Chair initiatives, such as the interdepartmental consulting committee, were set in place as secondary actions to insure that the above listed achievements were met in a timely matter and to a satisfactory level.

1.0 Overview of the Chair

The overall objective of the NSERC Chair in Design for Aluminium (DFAL) is related with the promotion and training of skilled engineers in aluminium products design through a project-based learning approach. The specific objectives of the Chair for its first mandate were:

- Develop and transfer the knowledge and expertise required to design products, rather than prototypes, where reliability, production and assembly constraints are properly taken into account; and
- Encourage the use of aluminium in product design from a cost/benefit/performance standpoint.

From the very beginning of its mandate, the Chair covered all educational levels: undergraduate, graduate and doctoral. The emphasis was however placed on the undergraduate level and the major theme was related to the application of design knowledge for aluminium. This included the following activities:

- Implementation of a multi-material assembly laboratory;
- Development of a course on the use of aluminium in design and the optimization and validation of products (GMC734 *Application de l'aluminium et des composites pour l'allégement des structures*);
- Donation of aluminium for capstone projects.

At the master's and doctoral levels, the Chair has gone further with an approach that encouraged creative design, and the development of innovative aluminium products. To this end, two research areas were investigated:

- Development of methodologies and advanced design tools; and
- Development of innovative aluminium materials and products.

Finally, in terms of continuous training, the approach used encouraged the acquisition of design skills in products using aluminium. The actions of the Chair in support of this component included:

- Development of courses and webinars on aluminium engineering;
- Creation of a network of business and industry involved in projects making use of aluminium.

2.0 Chair Structure

The Chair is essentially driven by Pr. Desrochers, senior chairholder. However, since the beginning of 2014, the Chair is supported by an interdepartmental consulting committee composed of the Associate Dean Academic, the Associate Dean to Research, the department Heads of Mechanical, Civil, and Electrical and Computer Science Engineering and a representative of the Research and Innovation Support Service at the University level. The purpose of the committee is to follow-up on Chair progresses and achievements while providing assistance and directions when needed. The committee is to meet at least once a year. However, special reunions can be called on specific issues at the faculty level or involving multi-disciplinary initiatives.

Following is an overview of the people involved in the Chair during its first mandate:

Senior Chairholder: Prof. Alain Desrochers, P. eng., Université de Sherbrooke.

All reported Chair activities have so far been conducted by the senior Chairholder. A team of technicians and professors from the Department of Mechanical Engineering (DME) has played a central role in the supervision and guidance of undergraduate capstone projects. Involvement of Prof. Desrochers at the graduate level is well reported in the Chair renewal proposal and in his F100 resume.

Industrial co-Chair : Russell Long, P. eng., Chief Design Engineer, Alcoa Technical Center, Pittsburgh, USA.

As presented in the original Chair proposal, five years ago, the Co-Chairholder's mandate is one of strategic guidance and technological support to both the Chairholder and students. His expertise complements that of the Chairholder and he was to actively help achieve the above-stated specific Chair

objectives. The main role of the Co-Chairholder is to further consolidate the development of design engineering at the Engineering Faculty. Practically speaking, Russell Long provided information and advices regarding the purchase of welding and riveting equipment for the aluminium assembly workshop and he always remained keen to offer his expertise to students looking for the most appropriate aluminium grade or assembly technique for any given application. In this, Mr. Long acted as the Chair connection with industry, therefore allowing student teams to get one step closer to real products rather than remaining in the first generations of the prototyping stage.

Director of Mechanical engineering department: Prof. Said Elkoun, Université de Sherbrooke.

The director of the Department of Mechanical Engineering has been very supportive of the Chair and has provided new opportunities such as enabling master degree students to evolve with the Chair in conjunction with industrial partners. In the scope of a pilot project, course based master degree students were awarded 15 academic credits while working a complete semester (4 months) on R&D projects with industrial partners.

Chair professional: Sylvain Vachon, P. eng. MBA, Université de Sherbrooke.

The Chair professional has been involved in all aspects of the Chair activities. This included technical and administrative support to students, establishing agreements with their industrial partners, meeting with potential industrial partners for new projects, monitoring aluminium donation to capstone projects and assisting students with the fabrication of prototypes.

3.0 Partnerships

During its first 4 years of operation, the design Chair was supported by three regular partners: REGAL, Alcoa and CQRDA. The following lines will explicit the extent of their involvement.

REGAL: The REGAL is a research centre on aluminium that is supported by the Fonds québécois de la recherche sur la nature et les technologies (FQRNT), the provincial equivalent of NSERC in Québec. REGAL was instrumental in the creation of the Design Chair as it was part of its strategic plan. In May 2015, the government of Quebec announced the renewal of REGAL's mandate for the next six years thus recognizing its strategic importance and guaranteeing that it will remain in a position to fulfill its commitment toward the Chair.

Alcoa Innovation: Alcoa's contribution is in kind, but is nonetheless central to the good operation of the Chair. Indeed, in addition to the involvement of Russell Long, industrial co-Chair, technical resources from Alcoa Innovation in Montreal also supported the chair activities. For instance, the Chair professional and Alcoa Innovation in Montreal joined efforts to solicit jointly Small to Medium size Enterprises (SME) for R&D projects aimed at graduate students.

CQRDA: The contribution of the Centre Québécois de Recherche et de Développement de l'Aluminium (CQRDA) was through grants to Small to Medium size Enterprises (SME) which would in turn use this support to participate in the chair while providing students with aluminum related design projects. As per new government imposed rules, the CQRDA financial support to SME has now become conditional to the establishment of a research partnership between SME and public research centers such as colleges or universities.

4.0 Financial Support

The budget presented on Table 1 includes contributions that are targeted at the Chair program and contributions that are dedicated to the student capstone projects themselves. Both types of contributions are required if the Chair is to achieve its goals.

Table 1 First term financial support for Chair program and student projects

Sources of funds		Chair program support			Student project support			Grand total (\$k)
		Year (\$k / year)		Total (\$k)	Year (\$k / year)		Total (\$k)	
		1	2 to 5		1	2 to 5		
Cash	NSERC	200	200	1000				
	Department of Mechanical Engineering (DME)	137	137	685				
	CQRDA	17	17	85				
	REGAL Research Center	15		15				
	Student project sponsors				170	170	850	
	Total cash contribution	369	354	1785	170	170	850	2635
In-kind	Alcoa Canada	50	50	250				
	REGAL Research Center	15	15	75				
	AAC, TransAl and others	15	15	75				
	Total in-kind contribution	80	80	400				400
Total budget (cash & in-kind)		449	434	2185	170	170	850	3035

In terms of actual contributions, data are still awaited to complete the picture for the current year. However, for the previous years, it is worth mentioning that the financial information provided on a yearly basis to NSERC have been deemed satisfactory. Hence, over 3 years (2012-2014), the total cash and in-kind contributions received toward the 35 undergraduate capstone projects amounted to 1 176 092\$. This figure will be revised in December 2015 as 12 more projects will have been completed.

5.0 Progress toward objectives

The following sections outline the actions that have been undertaken and the outcomes that resulted from the pursuit of the four objectives of the chair program.

5.1 HQP

The Chair support to the mechanical engineering curricula contributed to the graduation and competencies of the 544 bachelor students from the DME, through the support that the Chair brought them in their capstone projects and by providing them with additional knowledge on design toward products and the judicious use of aluminium in products. Regarding graduate students, the Chair may claim to have been instrumental in the project definition, financing and the training of 26 graduate students over the 5 years term of the Chair.

5.2 Design and Development

Design and development of innovative products is central to the Chair on Design for Aluminum and the Université de Sherbrooke Mechanical Engineering programs. During the 2011-2015 periods, 60 undergraduate capstone projects were initiated by students, among which 29 (48%) were undertaken with no official partners, whereas 31 projects (52%) had the support of industrial partners. All prototypes were exhibited publicly at the yearly MégaGÉNIALE event which, for the first time last year, featured capstone projects from all four departments of the faculty (mechanical, chemical, electrical and computer science, and civil engineering). Impressive multidisciplinary project prototypes were also exhibited to expose the power and complexity brought in by the integration of software and electronics in mechanical products, among other things. The Chair professional has been involved in the organization of this event which is to become a showcase of design engineering ingenuity and a most powerful means of promoting engineering and science. Indeed, the MégaGÉNIALE exhibition attracts hundreds of visitors each year and has grown to a point such that it is now being covered by the regional media. Groups of kids from primary schools tour the exhibition under the guidance of students who are always pleased to present their work.

5.3 Collaboration

Internally, the Chair was to foster collaboration amongst departments in the engineering faculty. Practically speaking, internal collaboration was essentially brought about by multidisciplinary projects whose nature calls for expertise from different fields. Table 2 presents such projects that have been taken-on by undergraduate students from the departments of mechanical engineering and electrical and computer science engineering. Globally, several important actions have been targeting the support of multidisciplinary projects in engineering programs:

- Creation of the Association for electric transportation of the Université de Sherbrooke (ATÉUS) whose purpose is to manage academic and extracurricular undergraduate projects associated to electric and hybrid vehicles;
- Organization of the annual MégaGÉNIALE, trans-departmental, undergraduate, capstone exhibition at the faculty level;
- Scientific leadership of a major (11,4M\$) collaborative grant from the Automotive Partnership Canada (APC) with the Centre de technologies avancées (CTA) and BRP (formerly Bombardier Recreational Products) for the development of a hybrid/electric three wheels roadster. The grant duration and objectives matched quite exactly those of the Chair and a follow-up to the project is planned in the form of an NSERC Collaborative Research and Development (CRD) grant application to be submitted in the fall 2015 semester.

The collaboration with the Centre de technologies avancées BRP - Université de Sherbrooke (CTA) is worth insisting on as it conveys admirably well the spirit of the design Chair at the graduate level. Indeed, all 22 graduate students and post-doctoral fellows in the APC project have been hosted in the CTA building, alongside the prototyping facilities. The research model of the CTA, validated through the many students who have completed their studies, is also to be extended to other potential partners in the second term of the Chair.

Taking collaboration one step further, a high profile project took place and engaged students from different horizons. Indeed, a unique team was assembled to tackle a multidisciplinary

project aiming at conceiving and fabricating a cauldron for the Canada Games to be held in Sherbrooke in 2013. Teaming up in the project with their specific competencies were three local secondary and postsecondary institutions: Bishop's University Department of Fine Arts for the artistic design, Université de Sherbrooke for the engineering and process planning and the Lennoxville Vocational Training Centre (LVTC) for the fabrication and assembly of the artwork. The collaborative aspect of the project was the main driver and the topic of an investigation which led to a paper at the 2013 Canadian Engineering Education Association Conference. The cauldron will be used for the next ten Canada Games, therefore leaving a lasting legacy.

5.4 Promotion

One of several promotional activity organised by the Chair was a breakfast meeting at the Longueuil campus of the Université de Sherbrooke. The event was held on April 23rd 2013 with approximately 40 peoples attending the activity which featured speakers from CQRDA, Alcoa and the Chair offering the attendees some resources to support aluminium related industrial research.

Moreover, the chairholder was invited as a guest speaker at the 2013 International Aluminium Conference (INALCO) that was held in Montreal on October 22nd-23rd. At this conference, the Chairholder delivered a 3 hours lecture on the use of aluminum in the transportation industry.

The chairholder also presented publicly in other aluminium related events in Montréal, Sept-Îles and Trois-Rivières. For instance, the chairholder was invited to address the public in a luncheon organized by the Saguenay chamber of commerce on April 18th 2012. The main topic of this presentation was the establishment of partnerships for aluminium related business with the CTA (Centre de technologies avancées BRP-Université de Sherbrooke) and the Chair in design for aluminium.

The chairholder gave an interview to Radio Canada Winnipeg in order to discuss the public unveiling of the cauldron that took place on July 5th 2013. The chair also got full media coverage from coast to coast when the aluminium Canada Games Cauldron was lit in the stadium at the 2013 opening ceremony. The cauldron was lit again at the Prince-Georges Winter Canada Games 2015 opening ceremony.

On February 19, 2014, the chairholder was solicited for another interview at Radio Canada, but this time in Windsor, to comment on the impacts of the new aluminium Ford F150 light duty truck on the aluminium sheet metal supply chain and the automotive industry in general.

On November 18th 2014, Université de Sherbrooke was hosting the REGAL student's day. This exhibition was free and open to the public. All graduate students from across Quebec presented the results of their research projects on aluminium. 136 participants took part to the event.

Finally, the chair was invited to share its knowledge with the government of Quebec to help prepare a brand new aluminium industrial policy that is expected to take place over the next decade (2015-2025). Therefore, on October 31st 2014, the Chair presented its view on aluminium transformation and end-user product design to a group of 5 high-ranking officials. The Chair was also invited to a closed meeting that was held on February 2nd 2015, under the leadership of the

honorable Québec Prime Minister who sought the opinion of key players from industry and academia, over a listing of 24 proposals.

From a more general perspective, the ATÉUS was instrumental in promoting multi-disciplinary projects related to electric vehicle and transportation systems as the following lines testify:

2012 :

- Presentation of 3 prototypes to the EV2012 Conference by EMC Canada;
- Presentation of 2 prototypes at the Québec Auto Show.

2013 :

- Presentation of 4 prototypes at the Longueuil UdeS campus during the Formula 1 Grand Prix du Canada;
- Host of the event “The power of choice” with Ford, where electric vehicles were on trial; an article in the regional newspaper “La Tribune” echoed the event.

2014 :

- Presentation of a prototype at the Montréal Auto Show;
- Host of the event “Rendez-vous Branche” (Connected meeting) with Équiterre an organization promoting sustainable development;
- Selection of 5 ATÉUS projects as finalists to the “Gala Forces Avenir” an event recognizing students achievements across the province;
- Article on the E-Volve project (Shell Eco-marathon Americas 2014) in the December 2014 edition of the “Plan” magazine from the Québec Professional Engineer Order;

2015 :

- Presentation of the Beyond project (Shell Eco-marathon Americas 2016) at the “Brancher, les gars” (Connect, Guys) an event organized by the Eastern Townships Scientific Leisure Council;
- Presentation of the EMUS electric motorcycle prototype at the Motorcycle Show Montreal;
- Graduate students recruitment evening toward ATÉUS, CTA and Chair design projects, held on May 13, in a local brasserie with chairholder and others.

6.0 Impacts on Undergraduate Training

The following table is a summary of the capstone projects that were undertaken during the first Chair mandate. The budgetary informations were not reliably available for the year 2011 and they are not yet compiled for 2015.

Table 2 Undergraduate capstone projects summary

<i>Year</i>	<i>Teams</i>	<i>Students</i>	<i>Budget (\$)</i>	<i>Sponsored</i>	<i>With industrial partner</i>			<i>Using aluminium</i>
					<i>Private sector</i>	<i>Public sector</i>	<i>Non profit</i>	
2011	13	107	Unknown	7	5	0	1	9
2012	12	109	478 989	9	3	0	0	6
2013	12	119	395 441	4	5	2	1	6
2014	11	100	301 662	4	3	3	1	8
2015	12	109	TBD	5	2	4	1	9
Total	60	544	1 176 092	29	18	9	4	38

Of these projects, at least one per year was multidisciplinary in nature, dealing essentially with electric or hybrid vehicles and involving students from the Department of Mechanical Engineering (DME) and the Department of Electrical and Computer Science Engineering (DECSE). Table 3 offers a summary of those projects, which have been supported by 8 professors from DME and an additional 2 or more from DECSE.

Table 3 Undergraduate multidisciplinary capstone projects

<i>Year</i>	<i>Teams</i>	<i>Students</i>	<i>Budget (\$)</i>	<i>Departments</i>	<i>Description</i>	<i>Prize</i>
2011	FSHS	20	120 000	DME & DECSE	SAE Hybrid Formula Car	1 st place, Loudon 2012
2012	ABYSSE	20	63 215	DME & DECSE	Submarine for submerged mines	
2012	VUE	27	112 934	DME & DECSE	Electric Car Smart	
2013	E-Volve	23	97 035	DME & DECSE	Shell Eco-marathon Americas 2014	1 st place, Urban concept, elect. vehicle
2014	EMUS	20	70 490	DME & DECSE	Electric Motorcycle	
2015	Beyond	20	53 500	DME & DECSE	Shell Eco-marathon Americas 2016	
2016	HelITE	6 + ?	(48 000)	DME & DECSE	Electric “Quadricopter”	
2016	ZEUSS	6 + ?	(60 000)	DME & DECSE	SAE Clean Snowmobile Challenge 2017	
Total		130	517 174			
2011-2015						

Supporting undergraduate training was the core mandate of the Chair, which translated into four main actions for its first term:

Action # 1: Gathering information and knowledge

- Reference books such as the “2010 Aluminium Design Manual” were identified by Mr Russel Long and purchased by the Chair. Other valuable references from the NASA, among others, were also collected by graduate students. Three reference books from the Editor “Les presses de l’aluminium – PRAL” were also purchased.

Action # 2: Setting up an assembly workshop for aluminium

- To that end, the Chair purchased new technologies that are now used by our students to build their prototypes. A welding machine was purchased with the advice from the co-chairholder. A riveting machine was made available to the students and a waterjet technology was also installed in the assembly workshop. This later piece of equipment was indeed a huge investment that is also quite uncommon in universities. Together, these acquisitions were worth over 170 000\$. The waterjet technology was chosen over laser cutting technology for versatility reasons knowing that it can cut a wide range of material such as steel, concrete, stone, wood, rubber, plastics, etc... The equipment was installed in late 2014 next to the wind tunnel (no relation) and is expected to be extensively used by the undergraduate students in the fall semester, as they construct their prototypes.

Action # 3: Developing courses on assembly for aluminum and product reliability and manufacturing

- Several interns were hired (Jean-François Duffault – Nicolas Roy, Nicolas Paradis, Jordan Longval) to help develop a brand new course entitled “Structural lightening for the transportation industry”. All the information is structured and organized on the university Moodle site. Course material include specifically made textbook style documentation with accompanying slides (PowerPoint), case studies with real examples of structural lightening and laboratory experiments with written instructions and short videos. Prof. Saïd Elkoun was involved in the part of the course related to composites and Prof. Ahmed Maslouhi for the material fatigue issues.
- Mr. Russell Long and two colleagues from the Alcoa Technical Center (Donald Spinella and Daniel Bryant) have played an important role in disseminating aluminum knowledge through a series of six webinars. Each webinar was a 1 hour presentation delivered to a class of 40 students with another 40 industrials or so, located around the Province of Quebec and attending the presentation remotely. The webinars, organized with the assistance of Alcoa Innovation, provided a unique expertise to complement more traditional course contents, while reaching a wider audience. Hence, three webinars were given each two times between March 2013 and March 2015:
 - *The Future of Aluminium Use in the Auto Industry* by Russell Long;
 - *Joining Methods Used in Aluminium Structures* by Donald Spinella;
 - *Rolled Products* by Dr. J. Daniel Bryant.

Action # 4: Integrating aluminium in undergraduate design projects

- Supporting capstone projects with aluminium has been a continuous undertaking throughout the first mandate of the design Chair. Hence, aluminium was provided free of charge to the students for their undergraduate capstone projects. The chair contributed financially to support the purchase of aluminium with an average contribution worth approximately 4 000\$ per year. Out of a total of 60 capstone projects over five years, 38 have used aluminium in their design. The chair supported primarily the projects that had no external partners. Overall, this provided students with an opportunity to explore aluminium assembly techniques by incorporating this material in their projects.

7.0 Impact on Graduate Training

At the graduate level, the Chair contributed to the training of 26 highly qualified personnel (HQP) through industry-driven design projects. Hence, 4 students have been involved in industry-born projects with Small to Medium Enterprise (SME) in the last three years:

- Caroline Celette (Doctoral degree – 18 months) – With MC2RI – The objective of the project was to design a state of the art submerged turbine that would harness the power of rivers to produce electricity. Unfortunately, the project was stopped before completion because of legal and funding issues, prompting the student to abandon her Ph.D. Robin Saillet (Master degree, course based – 8 months) – With CE Fibre de Verre – The objective of the project was to design a swimming pool accessibility system for handicapped people. The student wrote a 15 credits essay which included a 3D model and 2D fabrication drawings. A prototype was never built but the project is expected to be transformed into a capstone project for the next cohort of undergraduate students.
- Robin Saillet (Master degree, course based – 8 months) – With CE Fibre de Verre – The objective of the project was to design a swimming pool accessibility system for handicapped people. The student wrote a 15 credits essay which included a 3D model and 2D fabrication drawings. A prototype was never built but the project is expected to be transformed into a capstone project for the next cohort of undergraduate students.
- Sylvain Lecornu (Master degree, course based – 4 months) – With Remorques Savage – The objective of the project was to design a deckover tilt aluminium trailer. Such a trailer had already been built in steel but not in aluminium. The student wrote a 15 credits essay which included a 3D model and 2D fabrication drawings. The trailer manufacturer was pleased with the result and a prototype was expected to be built later in 2015.
- Sébastien Roche (Master degree, course based – 4 months) – With Champagne et Frère – The objective of the project was to design an all-aluminium dump box that would replace the original box of a pick-up truck. The main challenge was to develop a special extrusion that would clip together so as to form the floor of the box. Again, the student wrote a 15 credits essay which included a 3D model and 2D fabrication drawings. A prototype is expected to be built in 2016.

Additionally, the Automotive Partnership Canada (APC), multidisciplinary effort for the development of a hybrid/electric propulsion roadster involved 12 professors and 22 graduate students and post-doctoral fellows in fields as varied as power electronics, control, mechanical design, structure, thermal management and aerodynamics. Below is a listing of the graduate students who have been involved in the project and whose research subjects were directly related to aluminium. Additional details on other students can be found in the Form 100 (resume) of the chairholder.

- Christian Iorga (Doctoral degree – 48 months) – The objective of the project was to develop advanced validation methodologies and design tools. The integration of validation tools at the detailed design phase of the product development process (PDP) was itself validated in the

design of a tricycle frame for the Automotive Partnership Canada project to build a hybrid/electric propulsion roadster.

- William Rougé (Master degree, research based – 24 months) – The objective of this project was to study the fatigue behaviour of an aluminium roadster frame as part of a team effort with Ph.D. candidate Cristian Iorga, in the Automotive Partnership Canada project to build a hybrid/electric propulsion roadster.
- Yann Mogenot (Master degree, research based – 24 months) – The objective of his project was to investigate the eligible assembly processes for an aluminium roadster frame as part of a team effort in the Automotive Partnership Canada project to build a hybrid/electric propulsion roadster. This work preceded that of William Rougé.
- Maxime Tacher (Master degree, research based – 22 months) – Still in the scope of the Automotive Partnership Canada project, the objective of the work was to investigate various configuration and material for a roadster frame. This work served as a starting point for those of Yann Mogenot and William Rougé.

8.0 Problems Encountered

During its first term, the Chair did not experience any serious problem that could have impeded its capacity to achieve the program objectives. Nonetheless, a few minor annoyances are worth reporting.

- The chair professional was hired in July 2011. As this new resource joined the team, a major strike of the support personnel was initiated which impacted the university operations and caused some delays in the Chair activities from the very beginning of its mandate.
- The major difficulty encountered by the Chair arose from the fact that the undergraduate students often prefer to work on their own ideas, which are not financed by external partners. Therefore, they must seek a number of sponsors, willing to support their ideas and projects. The selection process by which the undergraduate students gather in teams is very democratic. Indeed, the ideas are publicly presented by the different promoters which include the students themselves, some graduate students involved in technical groups, some professors who wish to push forward their own research program and also some industrial partners. After the projects are explained, a voting procedure takes place to narrow down the possibilities. It is quite common that 12 to 15 ideas of projects compete against each other to attract students when in fact there are enough students to form only five or six teams. Hence, the Chair has to work very hard to attract and convince businesses that it is worth submitting a project more than once in the hope of being selected. These companies often work on a tight schedule and are eager to get their project completed. They may thus feel disappointed when their projects get turned down by the students. In such a case, it was always hard to relight the flame and get the project presented again, months later, to a new group of students.
- Due to the low price of aluminium on the international market (low profitability), Alcoa provided aluminium for the capstone projects only in the first year of the Chair's mandate.

9.0 Appendix

List of events and realisations			
1	NSERC chair creation	Januray 1st	2011
2	Acquisition of a welding and riveting equipement	Winter	
3	The chair professionnall was hired	July 18th	
4	Strike of the support staff (4 months)	Fall	
5	Conference of Metallurgists COM2011. Short course on "Aluminum components and product design"	October 2nd	
6	Initiation of the Canada Games cauldron project - Sherbrooke 2013 (2 years project)	October 26th	
7	Défi Innovation Estrie Seminar on Aluminium - public presentation by the chair professionnall	Novembre 15th	
8	Joint visit CQRDA-UdeS of Posi+ technology (bachelor project financed by the CQRDA)	Novembre 17th	
9	Mécagéniale exhibition 17th edition	December 7th	
10	Public announcement of the chair to the media	March 19th	2012
11	Chairholder presentation on aluminum product design - ville Saguenay chamber of commerce (manoir du Saguenay)	April 18th	
12	First meeting with MC2RI (doctor degree project financed by the CQRDA)	April 19th	
13	Training provided by the Aluminium Association of Canada and the Réseau des Ingénieurs du Québec on aluminium usage	April 24-25th	
14	Creation of a project course GIN 950 for the design of the Canada Games cauldron (3 students of mechanical engineering enrolled)	September 1st	
15	Mécagéniale exhibition 18th edition	December 5th	
16	First webinar of Alcoa Innovation (Russel Long from the Alcoa Technical Center) - The future of aluminum use in the automobile industry	March 27th	2013
17	Organization of a breakfast meeting (Longueuil Campus with DEL, CQRDA and Alcoa Innovation)	April 23rd	
18	An internship was created for a bachelor degree student (Jean-François Dufault) to help prepare a course on aluminum	May 1st	
19	Public enveiling of the Sherbrooke 2013 Canada Games cauldron	July 5th	
20	Ignition of the Sherbrooke 2013 Canada Games cauldron live on television in university stadium at the opening ceremony in the presence of the prime Minister of Canada	August 2nd	
21	Alouette aluminum smelter representative vist to Sherbrooke (Richard Lapierre and Annie Thabet)	August 29th	
22	Conference of Metallurgists COM2013. Short course on « Design for aluminum in lightweight vehicles structures »	October 13th	
23	2nd webinar with Alcoa Innovation (Russel Long from the Alcoa Technical Center) - The future of aluminum use in the automobile industry	October 31st	
24	3rd webinar avec Alcoa Innovation (Donald Spinella from the Alcoa Technical Center) - Joining methods used in aluminum structures	November 21st	
25	Request for tender related with the purchase of a waterjet	December 1st	
26	Mécagéniale exhibition 19th edition	December 5th	
27	NSERC chair meeting at Estrimont hotel	Januray 13th-14th	2014
28	Evening awards for outstanding achievements organized by the burrough of Lennoxville (Canada Games cauldron)	February 20th	
29	Technical conference in Sherbrooke by Mr. Franco Chiesa and Nicolas Giguère from CMQ Trois-Rivières	March 19th	
30	4th webinar with Alcoa Innovation (Dr. J. Daniel Bryant from the Alcoa Technical Center) - Rolled Products	March 26th	
31	Two internship were created for two bachelor degree student (Nicolas Paradis et Nicolas Roy) to help prepare a course on aluminum	May 1st	
32	Course based essay at the master level with CE Fiberglass - student Robin Saillet (15 credits over 8 months)	May 1st	
33	Meeting with the new research consortium in metallic transformation (CRITM) at Trois-Rivières	October 9th	
34	Meeting with officials from the Economy, Innovation and Exportation Ministry about the 2015-2025 aluminum industrial policy	October 31st	
35	Course based essay at the master level with Savage Trailers - student Sylvain Lecornu (15 credits over 4 months)	September 1st	
36	Organisation of the 11th edition of the REGAL student's day in Sherbrooke	November 18th	
37	5th webinar with Alcoa Innovation (Donald Spinella from the Alcoa Technical Center) - Joining methods used in aluminum structures	November 20th	
38	Mécagéniale exhibition 20th edition	December 2nd	
39	Powerpoint presentation made for the University rectorship about "Sustainable development by vehicule lightening"	Januray 15th	2015
40	Closed meeting with the Prime Minister of Quebec about the 2015-2025 aluminum industrial policy	February 2nd	
41	6th webinar with Alcoa Innovation (r. J. Daniel Bryant from the Alcoa Technical Center) - Rolled Products	March 18th	
42	Research contract with Novatech (CTA-BRP-UdeS)	May 1st	
43	Course based essay at the master level with Champagne et Frère - student Sébastien Roche (15 credits over 4 months)	May 1st	
44	An internship was created for a bachelor degree student (Jordan Longval) to help prepare a course on aluminum	May 1st	
45	Course based essay at the master level with Champagne et Frère - student Louis Jones (15 credits over 4 months)	September 1st	