

## ANNUAL REPORT TEMPLATE: CHAIRS IN DESIGN ENGINEERING<sup>1</sup>

**Report Due Date: May 6, 2016**

**Please add your personal information below.**

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**Please verify the information below and make the necessary corrections.**

Chair in Design Engineering Name: "NSERC Chair in Design for Aluminium"

Partner name & contacts:

- Aluminium Association of Canada (AAC), Jacques Internoscia, Director Strategic Programs (new partner for 2016)
- REGAL Aluminium Research Centre, Mario Fafard, Director
- Alcoa Innovation, François Racine, President
- Centre québécois de recherche et de développement de l'aluminium (CQRDA), Maurice Duval, Scientific director

**Top 3 contributions for the year.**

1.

*Pilot project for a course-based M.Sc.A. in design with internship:*

From the Chair in design program perspective, this proposition allows the progressive evolution of design and project based learning into graduate programs. So far, pilot experiments have been conducted in the Department of Mechanical Engineering (DME) in 2014, with two students successfully designing an aluminium trailer and a pool access ramp for disabled persons, and one more student working on an aluminium tipper box for pick-up trucks in 2015. In 2016, six more course based M.Sc.A. and two research based M.Sc.A. are currently working on the design of a family of structural panels and floor extrusions for the transportation industry. It is now foreseen that the new proposed course-based M.Sc.A. in design with internship will go ahead as an offspring of the regular course-based M.Sc.A. within the coming year.

2.

*Pedagogical capsules supporting laboratory learning and students self-certification training:*

One outcome from the first term of the Chair was to set up laboratory experiments with the dual objective of having the students characterize material samples and assembly techniques while learning to use the various equipment available in the Chair assembly and validation workshop. To that end, two internship students (Jordan M. Longval and Olivier Moriceau) were hired in 2015 to create short video capsules to support self-learning and prepare students for laboratory demonstrations and experiments. This initiative is being continued in 2016 with a course based master degree student (Charles Breton) working on a comprehensive capsule offering, taking into account best practices and safety regulations, so as to provide students with an internal certification program that will allow them to operate the workshop equipment more autonomously.

3.

*Participation to the definition of the "Québec Aluminium Development Strategy":*

The chairholder was invited to share its opinion toward a new Québec aluminium industrial policy to take place over the next decade (2015-2025). Hence, on October 31<sup>st</sup> 2014, the Chair presented its view on aluminium transformation and end-user product design to a group of 5 government officials. The Chair was later invited to a closed meeting that was held on February 2<sup>nd</sup> 2015, under the leadership of the Honorable Québec Prime Minister who sought the advices of key players from industry and academia, over a listing of 24 proposals. The "Québec Aluminium Development Strategy" was officially rolled out in June 2015 and aims at doubling the aluminium transformation in Québec, within the next decade. The Chair was identified as a contributor to the training aspects of the strategy and was granted a 33 K\$/year support (pending) toward that objective.

**Best Practices**

Please present one best practice implemented, to share with other CDE Chairholders.

1.

*Maximize Chair visibility and exposure in its renewal year:*

As can be seen in the Chair structure section, the Chair partners are all from the aluminium industry and share a common mandate geared toward the promotion of aluminium usage in products. Hence, quite obviously, the Chair renewal year becomes one of outcome assessment and strategic guidance for the next term. Reporting to and consulting Chair partners at this critical moment is indeed mandatory to insure that: 1) The partners are aware of the Chair achievements and visibility, 2) The Chair remains on track regarding the aluminium industry trends and priorities for the next term, 3) The partners remain aware of the importance of highly qualified personnel (HQP) training in design for Canada and the aluminium industry and, 4) The partners commit themselves financially to further support the Chair for a new term.

## 1. Overview

### a. Chair Structure

Please provide an overview of the participation in and contributions to the CDE action plan of each member of the Chair's team (Chairholder(s), professional staff, company experts, collaborators, post-doctoral fellows, students, etc.).

<b>Chair resources</b>		<b>Mandate/interests</b>	<b>Relation to Chair</b>
<b>Partners</b>		<b>Promotion of aluminium in products and HQP training</b>	
	NSERC	Fulfilling the Chair in Design Engineering mandate and sharing best practices amongst Design Chairs	
	Aluminium Association of Canada (AAC)	General interest in Chair mandate toward aluminium in finished products (new partner for 2016)	Chair reporting to partners *****
	CQRDA	Provincial granting agency supporting the development of aluminium products	Partners providing aluminium related projects, knowledge & funding
	REGAL Research Centre	Graduate student training and research toward aluminium applications	
	Alcoa Innovation	Production of webinars for knowledge diffusion of aluminium uses	
	Ministry of Economy, Science and Innovation (MESI)	Québec aluminium strategy: Training of professionals fostering the use of aluminium in product design (to be confirmed)	
<b>Faculty resources</b>		<b>Supporting and facilitating the execution of the Chair mandate across the Faculty</b>	
	Dean	Overseeing Chair accomplishments and granting space for Chair initiatives	Chair reporting to Dean and Interdepartmental committee *****
	Program directors	Formal integration of Chair proposals in academic programs (undergraduate and graduate)	Program directors and collaborators as contributors to Chair objectives
	Chair interdepartmental committee	Providing advices and political support as well as additional connections to the rectorate	
	Chair collaborators	Technical expertise from the many colleagues involved in design projects and research targeting aluminium usage	

<b>Chair internal resources: Aluminium oriented</b>		<b>Human resources reporting to the Chair for the "aluminium track"</b>	
	Post-doctoral fellow (PDF) #1 (to be recruited)	Supporting the many aluminium specific Chair initiatives and conduct an original research program on aluminium generic technologies (structural panels & extrusions, assembly methods, etc)	
<b>Chair internal resources: Product design oriented</b>		<b>Human resources reporting to the Chair for the "design track"</b>	Chair plan execution by internal team *****
	Post-doctoral fellow (PDF) #2 (to be recruited)	Supporting product design activities and pursue new research projects related to customer needs, load case identification and product validation	Internal team delivering expected outcome as per Chair program
	Coordinator of the product and load cases characterization facility	Management and operation of the facility equipment (Claude Dugal, mechanical engineering technician)	
	Mechatronics professional (conditional to MESI contribution)	Providing students with help and expertise regarding the use of data acquisition and control systems hardware and software	

#### b. 5 Year Term Objectives Overview

Please provide a brief overview of your Chair, its goals and objectives.

The general mandate of the Chair is to promote the training of competent engineers in the design of aluminium products through project-based learning. This mandate is twofold: 1) to develop and teach knowledge and expertise on the design of products, rather than prototypes, where reliability, manufacturing and assembly constraints are properly taken into account and 2) to encourage the use of aluminium in products from a cost/benefit/performance perspective. The Chair supports undergraduate and graduate programs from the departments of Mechanical, Electrical and Computer Science as well as Civil Engineering.

#### c. Annual Objectives/Tasks

Please provide a list of the activities that were to be achieved in the past year and your progress toward these objectives.

For 2015, the focus was on maintaining what had been achieved in the prior years and to prepare an inspiring renewal program for the Chair. This implied consulting colleagues both at the university and CDE levels so as to imagine the next trends in design engineering education and how best to support an ever increasing number of students. From a partner's point of view, the Chair needed to remain visible and to report the achievements of the first four years of activities while demonstrating its relevance to the aluminium industry, its main sponsor. All of these actions were successful, as all partners from the first term chose to renew their

support with equal or greater contributions. Moreover, a new, important partner, the Aluminium Association of Canada (AAC) joined rank with a 25K\$/year cash contribution, therefore testifying to the recognition the Chair had earned in its first mandate. At the provincial level, the Chair has been identified as a key contributor to the Québec Aluminium Development Strategy and, as such, should benefit from a 33K\$/year contribution from the ministry of economy, science and innovation (MESI).

d. Objectives/Tasks for Upcoming year

Please provide a list of the activities that you are planning for the upcoming year.

2016 will be the first year of the second mandate and as such, should see the initiation of several actions targeted toward graduate programs: a) Offering a course-based master degree in design with internship; b) Developing a project portfolio for industrial projects in research-based program (master and Ph.D.); c) Addressing publications in non-disclosure environment; d) Recruiting and training post-doctoral fellows to become the next generation of design professors.

In addition to the graduate program oriented initiatives, support to design projects will be further enhanced with the development of web-based, laboratory training material, the set-up of a "product and load cases characterization facility" and the continued furniture of aluminium for student projects. The recruitment of a professional in mechatronics and data acquisition to provide expertise in those fields and oversee the "product and load cases characterization facility" is also on the agenda.

e. Impact of Semi-Annual meetings

Please describe the influence last year's semi-annual meetings have had on your Design Chair. Note any impact or changes as a result of the meetings.

The 2015 summer meeting gave me the opportunity to present my Chair renewal proposal and get feedback from my fellow chairholders prior to submitting it to NSERC. Their questions and concerns allowed me to improve the rationale behind the new Chair program. Conversely, in the following winter meeting, I was pleased to find that other colleagues had taken on the shift toward graduate study as a natural evolution of undergraduate design engineering education, as I advocated.

## **2. Established Partnerships**

Briefly describe the nature and extent of the involvement of the partners. Include details on how the results have been communicated to the partners (e.g. meetings, reports) and how the industrial partners have transferred knowledge and know-how to the university students, staff, and faculty.

In 2015, three regular partners have supported the Design Chair: REGAL, Alcoa Innovation and CQRDA. The extent of their involvement is still in line with their initial commitment.

Alcoa's contribution is in kind, but is central to the good operation of the Chair. Indeed, it includes the involvement, as industrial co-chair, of Russell Long, Chief Engineer, Ground transportation, at the Alcoa Technical Center (ATC) in Pittsburgh as well as technical resources from Alcoa Innovation in Montreal. Joint webinars are regularly broadcasted from the Université de Sherbrooke and the ATC.

The contribution of the Centre Québécois de Recherche et Développement de l'Aluminium

CQRDA was through grants to Small to Medium size Enterprises (SME) for projects involving students from the Université de Sherbrooke.

The REGAL Research Centre on Aluminium was instrumental in the creation of the Design Chair as it was part of its strategic plan. REGAL promotes collaboration and support toward aluminium related projects at the graduate level.

### 3. Sources of Financial Support

Please provide information about the cash and in-kind contributions received during the past year, noting the impact on the Chair activities as well as the estimated values for Chair leverage.

Owing to problems related to its professional (see last section of this report) it has not been possible to gather accurate figures related to the projects in 2015. However, nothing can lead us to think that this year would be better or worse than previous ones. 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\$ or 392K\$/year. On an annual basis the Chair could also count on a 169K\$/year cash (excluding NSERC) and 80K\$/year in-kind contributions from Chair partners in support of the Chair program.

### 4. Progress to Date

Please describe the progress to date made toward the following objectives.

#### a. Training

Please include all relevant information about courses developed or modified by the Chair focusing on design, the impact of these courses as well as any involvement in competitions etc. Please include the number of students impacted.

##### I. At the undergraduate level

Design and development of innovative products are central to the Chair on Design for Aluminum and the Université de Sherbrooke Engineering programs. In 2015, owing to its continued success, the traditional mechanical engineering "Mécagéniale" yearly capstone projects exhibition was extended to all six engineering programs and was aptly renamed "Mégagéniale". The undergraduate capstone projects that have been presented publicly at the 2015 exhibition are listed on the engineering faculty web site and drew several hundred visitors, including K12 students, along with the local medias. The extension of the undergraduate capstone projects exhibition beyond mechanical engineering is obviously in line with the CDE program objectives as it now reaches over 500 engineering students.

##### II. At the graduate level

A research and design project called dSkibel, aiming at reducing the noise of BRP snowmobiles, was launched in the fall of 2013. The project is now nearing and end and 2015 saw the peak of the research effort, with graduate students delivering the final prototype in March 2016. Concurrently, a major Automotive Partnership Canada project on the development of an hybrid roadster with BRP, officially ended in December 2015. Overall, in 2015, the chairholder supervised or co-supervised 5 M.Sc. and 5 Ph.D. students in projects related to the design or improvement of products. Tellingly, out of those 10 graduate students, 8 were working on industry-sponsored projects.

b. Design and Development

Describe all relevant information about the design and development of innovative products, processes, systems and technologies.

At the Université de Sherbrooke, student training and design and development are closely entwined, making it difficult to clearly separate one from the other. Hence, what has been said in the previous two paragraphs regarding undergraduate and graduate students is easily applicable to this section.

c. Collaboration

Describe any collaborations and interaction of the Chair with the department, faculty, university and outside colleagues during the past year in connection with the CDE action plan. Include collaborations with other CDEs, but do not include the Chair's regular workshop meetings.

Internally, the Chair is 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. One notable example from 2015 is the Beyond project which involves 20 students from the department of mechanical engineering and the department of electrical and computer science engineering, with a budget of 53 500\$, in a bid to participate to the Shell Eco-marathon Americas 2016.

d. Promotion

Describe any events and activities that were organized to raise the awareness and appreciation in the research and outside communities for all aspects of design engineering.

As indicated in the top three contributions, in February 2015, the Chairholder was invited to be part of an exclusive consultation process led by Jacques Daoust, then Québec Minister of Economy, Innovation and Exportation (MEIE) and Philippe Couillard, the prime minister of Québec, toward the establishment of a Québec Aluminium Development Strategy, one of three national strategies being crafted. The strategy, unveiled on June 19, 2015, includes a proposition to "integrate aluminium in the academic curricula at both bachelor and master degree levels for certain key professions (engineers, architect, industrial designers, etc.)". This is exactly in line with the message that the Chair took to the consultative committee when he got to meet with it.

Other actions toward the promotion of engineering design include the following:

- 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 (Association des transports électriques de l'Université de Sherbrooke), CTA and Chair design projects, held on May 13, 2015, in a local brasserie with the chairholder and several others.

## 5. Problems Encountered

Identify the main problems encountered during the past year, their impact and the steps taken to resolve each issue.

In 2015, the Chair encountered serious human resource problem with its own professional who sought a way, any way for that matter, to secure its employment for the second term of the Chair. More specifically, as a university professional, he sought the authorization to negotiate contracts with companies as a freelancer would, which I refused on the basis that: 1) The role of the Chair is to introduce industrial projects for the students, not for itself or its professional, 2) Offering engineering services in design would amount to unfair competition against private engineering service firms and our own graduates, 3) The professional, personal interests and literacy were in project management and I came to grasp with its technical incompetency at several occasions, and 4) The Chair needed the professional internally for reporting purposes and to support students and the use of aluminium in capstone projects.

Having rejected his demand to create his own job, the professional carried his request as high as he could in the administrative ladder (department chair, dean, human resource and the university professional union). Moreover, to put pressure on me, he privately negotiated his involvement in an industrial contract as an in-kind contribution and tried, unsuccessfully, to put me before the fact. As I was very much involved with the Centre de technologies avancées BRP - Université de Sherbrooke (CTA), he also started to insinuate that he would never know whether I was assigning him to a Chair or a CTA task, implying that I was – may be – misusing Chair funds. In the end, there was enough evidence to fire him, but the university found it less constraining to simply leave the professional contract run to an end, as the renewed Chair would not need such a position for its second term.

Owing to its cumulated years of experience, the professional found another position and is therefore still employed by the university...

Practically speaking, this also meant that for most of 2015, the Chair could not rely on its professional, making project follow up and reporting all the more difficult, especially in a renewal year.

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<sup>1</sup> In this document references to Chairs in Design Engineering (CDE) also should be interpreted as referring to Chairs in Environmental Design Engineering (CEDE).