

CAS: A Sustainable Industrial Research Collaboration Model

Joanna W. Ng

IBM Canada Software Laboratory, CAS Research

jwng@ca.ibm.com

Abstract

IBM formed the first CAS (Centre for Advanced Studies) twenty-five years ago in IBM Toronto Laboratory, with its original mission of *applied research transfer* from academic partners to IBM product development teams. A mutually beneficial CAS model was established, and formally published in IBM Systems Journal since its beginning. The CAS model has stood the test of time for the last twenty-five years. In the last decade, with confluences of transformations in the industry and within IBM as a company, coupled with fast emergence of multiple disruptive but impactful new technologies, in order to embrace the wave of a technological and industrial tsunami of changes, CAS has evolved from a model of academic research transfer to a model of *industrial research collaboration and partnership*. This paper summarizes how the CAS model has evolved over time to ensure research relevance and timely innovation impact amidst these major transformations. It also calls out the importance of establishing innovation metrics, in order to ensure effective communication of success. This paper also highlights a subset of successful outcomes as a result of these CAS evolutions.

Keywords: *CAS, CASCON, Industrial Research, Research Collaboration, Innovation, Languages of Innovation, Innovation Metrics*

1. INTRODUCTION

IBM's Centre for Advanced Studies (CAS) was first established in 1990 in then IBM Toronto Software Lab as an applied research centre. Its primary goal is to "facilitate the transfer of research ideas into the various product groups" [1]. A CAS research operation model was established at the time, reflecting the understanding of the

critical importance of interactions between academic research and software development communities. The original CAS model carefully considers the differences in the measures of success in academia and in IBM as an industrial partner, and designed a CAS operation model that focuses on the win-win of all parties.

I have the great honor to be appointed as the Head of Research for CAS from 2008 – 2015. When I first started my role in 2008, IBM Toronto Software Lab had just evolved to become IBM Canada Software Lab. It was also a time when forces of disruptive technologies such as cloud computing, mobile computing, social computing, big data analytics and Internet of Things started to emerge, drastically changing the industrial landscape and IBM as a company. In order to face such a time of massive changes, CAS has evolved beyond a model of "*applied research transfer*" into a model of "*industrial research collaboration and partnership*". In this industrial research collaboration model, IBM shares with CAS academic partners problem statements we receive from our enterprise customers, and IBM's business strategies and priorities. This shapes CAS research scope in all CAS initiatives; critical in ensuring our research relevance. It is also necessary in order to ensure our contributions and advancements out of our collaborative research effort have business and technological impact. In addition, finding an efficient approach to crisply articulate back to the business the return on research investment in CAS, in a manner that resonates, is of critical importance, as economics are getting tightened year over year.

The remainder of this paper is organized as follows. Section 2 re-captures the key elements of the classic CAS industrial collaborative research

model. Section 3 reflects upon the major refinement of the CAS model in light of the vortex of emerging technologies that transform IBM from within and the industry at large. Section 4 highlights its successful outcomes. Section 5 concludes the paper.

2. THE CLASSIC CAS MODEL

The CAS model [1] is expressed as a set of fundamental CAS principles that operationalize the mission of *applied research transfer* from academic partners to IBM product development teams. A subset of these CAS principles are highlighted here, namely:

The principle of *Win-Win design* is focused on the selection of a research agenda that benefits and fits the business and academic interests of both IBM and academia.

The principle of *mission-driven projects* shapes research project selection criteria, focusing on research projects with direct innovation and business impact in the short-to-midrange timeframe.

The principle of *cooperative arrangement with experts and personal contact and networking* highlights the importance of research relationships built upon relevant expertise, with personal contacts and long term working relationship of collaboration history that builds trust.

The principle of *product development funding and leverage of matching funds* is designed for a low innovation and development cost from IBM with a high yield of research outcome by leveraging the matching of federal and provincial research fund matching, minimizing IBM's financial risk in organic innovation.

The principle of *focusing on prototypes* is designed to ensure that research outcomes from academic partnerships are implementable.

The classic CAS model also includes a set of CAS processes in identifying problems, defining the scope of research project, forming the collaborative research team over the established project scope.

A set of CAS initiatives was birthed since then. Centre for Advanced Studies Conference (CASCON) is one of these CAS initiatives. We are happy to be a part of its quarter-century anniversary celebration. Over time, it has evolved to become a premier, international industrial academic conference in computer science and software engineering [3]. CASCON proceedings are available in the ACM Digital Library and are indexed [3].

Changes are inevitable. In the last decade, IBM as a company has gone through major organizational changes. IBM Toronto Software Lab. has evolved to become IBM Canada Software Lab, with multiple lab sites and a large collection of product portfolio with a wide spectrum of technologies.

In the last decade, multiple disruptive technologies have emerged as impactful forces that change the industrial landscape. Their confluence forms an industrial tsunami of transformations. When I was first appointed as the Head of Research for CAS in 2008, these disruptive technologies, namely, cloud computing, mobile computing, social computing, big data and analytics, internet of things, were just emerging and far from adoption maturity. Yet, we knew they were too critical to be ignored. CAS has since then evolved from a model of *academic research transfer* to a model of *industrial research collaboration and partnership*, in order for the entire CAS community together, from IBM practitioners, technologists and IBM product stakeholders, to CAS faculty academic partners, to work collaboratively as innovation and research partners, in order to produce research outcomes and thought leadership in these game-changing technologies.

3. KEY REFINEMENTS

In light of these major shifts in the industry, in technologies and within IBM as a company, several key refinements over the original CAS model had been put in place since 2008. These refinements are necessary in order to build a ***sustainable industrial research collaboration model*** that positions CAS Research's continual success going forward. These refinements also ensure CAS Research is able to bring in research-based thought leaderships that add value. These refinements are aimed to foster technology contributions that are

significant to the history of technology and to the industry at large.

3.1. CAS Technology Incubation Lab

The CAS Technology Incubation Lab (TIL) was birthed in November 2008. It was formed out of the realization that software development after successful research outcome is absolutely critical in commercialization. Commercialization is key to the sustainability of research investment. TIL is missioned to produce implemented prototypes, with code quality and strength close to product-level implementation. Prototypes produced demonstrate the realization of innovation concepts, providing technology-adopters an actual hands-on iteration to try and to provide feedback in usability, bringing credibility to research outcomes that paper solutions cannot. TIL leverages government post-doctorate industrial matching funds to maximize software development capacity with minimized cost.

3.2. Research Portfolio by Technology Themes

Starting 2009, CAS research projects are categorized under major technology themes, grouped into larger research portfolio [7]. This was designed to discover how these projects relate to one another in providing solutions to a bigger technology space. When related projects are being abstracted to a higher level of consumptions, it opens up opportunity for more technology contributions. High scale, low touch component of IBM cloud was harvested into commercialization under this approach.

Laying out research scope per projects within a larger technology theme (e.g. Cloud Computing) enables us to identify technology gaps from within, leading to problem statements to formulate the next round of research projects within a technology theme.

Eight major technology themes and three major industrial solutions were established since 2009 [7]. It is interesting to call out an observation that IBM re-structured itself in the beginning of 2015, creating business units per these technology areas that we have called out 2009.

3.3. Innovation Metrics in Four “P”s

Establishing innovation metrics that we can communicate efficiently in a manner that resonates among the business and the innovation community is critical in order to sustain the investment in the industrial research collaboration. It provides a very tangible expression of the CAS’s win-win model.

The Four Languages of Innovation [2] has been established since 2013 as CAS Research’s metric, expressed in units of measure in the number of patents filed, the number of publications and citation counts, the number of prototypes implemented and the number of productization accomplished. We internally call this the 4P metric model of innovation.

3.4. The Role of CAS Research Staff Member

The role of CAS Research Staff Member (RSM) has been expanded beyond the role of research coordinator into multiple additional roles such as researcher portfolio manager, subject matter expert as a technologist and architect of prototyped solutions, leading TIL to implement near-product level prototypes.

3.5. Position Paper Track in CASCON

Recognizing the fast speed of dynamics of these emerging technologies, we started a new “Position Paper Track” in CASCON since 2013 in order to provide a time-stamped approach to capture thought leadership in positioning that may be too pre-mature for validated research results to be published as technical papers.

My personal thanks to Dr. Jenny Zou from Queen’s University, Dr. Kenny Wong from University of Alberta, Dr. Hausi Müller from University of Victoria and Dr. Jim R. Cordy from Queen’s University, who are the pioneers in the formation of this position paper track, which we come to know today as “Emerging Technology Track” (ETT) in CASCON.

4. RESULTS OF INNOVATION

CAS has established a great heritage over the last quarter-century. The refinement of the CAS model, from a mindset of academic research transfer

to a truly collaborative industrial research model, has since yielded fruitful outcomes. CAS is well positioned to take on another quarter-century, with continual evolution to ensure research relevance and timely innovation impact. The following is a highlight of some of its accomplishments.

4.1 People

The pillar of success for CAS's quarter century is the CAS community. This includes CAS Faculty Members and Visiting Scientists who go above and beyond what is required, time and time again, to make countless contributions to CAS's success. CASCON's 25th Anniversary celebration is a testimony of such long-term commitment.

CAS Research's industrial research collaboration model also produces highly skilled personnel from CAS faculty students who are very much a part of the innovation journey. Not only they have proven their skills over a sustained period of time, they also gain skills in emerging technologies that are very difficult to find in the industry, making them prime candidates to hire into IBM.

4.2 Disruptive Innovation Outcome

With the establishment of CAS TIL and CAS Research portfolio, and a transition into an industrial research collaboration model, disruptive innovations have been led and birthed by the CAS Research Community. Critical product components in IBM cloud, called the High Scale, Low Touch cloud autonomic management is one of the poster-children of CAS's disruptive innovations. Other disruptive innovations birthed by CAS Research includes Social Relationships as a Service, Web Tasking, Talk to my Data, just to name a few. This is not intended to be an exhaustive list, but to highlight a glimpse of the innovation potential of CAS's "low-cost, high-yield" organic innovation model.

CAS Research has also started new research platforms, starting workshops in new research areas. Web Tasking [6], Smart Internet are a few examples [4].

4.3 Incremental Innovation Outcome

CAS Research continues to make fruitful contributions in incremental innovation outcome in

strategic IBM product portfolios, including IBM Security products, IBM Next Generation Systems and Compilers, IBM Analytic Product suite, just to name a few.

4.4 Publications

Since the establishment of the innovation metrics in the Four languages of Innovation, there has been an exponential growth of publications under CAS Research, from ten publications in 2007 to the peak of one hundred and fifty-four publications in 2012, now an average of ninety publications annually.

CAS Research has also started to publish CAS Research books through Springer. We have so far published two CAS Research books under Springer: namely "The Smart Internet" [4], and "The Personal Web" [5]. With so many new technologies emerging, more books need to be published in the future to capture the impactful research outcome that CAS research as a community has contributed.

4.5 Patents

Patents have not been a focus item until the innovation metrics were established. Since 2012, a steady annual average of twelve patents are filed from CAS Research.

5. CONCLUDING THOUGHTS

CAS Research has established a rich innovation and partnership heritage that is impactful for IBM as well as for the CAS academic community.

The CAS Model established since the beginning has proven its value over a quarter century. Refinements that are critical to CAS' continual success have been in place for CAS to embrace the next quarter century.

It has been my honor and privilege to serve this amazing CAS community in the last seven years. I want to take this opportunity to thank everyone for your commitment to CAS and wishing CAS all the successes in the future.

6. REFERENCES

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