# The Four Pillars of CAS

Marin Litoiu Department of Electrical Engineering and Computer Science School of Information Technology York University, Canada <u>mlitoiu@yorku.ca</u>

**ABSTRACT**: Over the last 25 years, the Centre for Advanced Studies (CAS), at IBM Toronto Lab, has established itself as a world model of collaborative research. I am among the few lucky people who experienced CAS from different perspectives: I was a CAS *student*, an IBM CAS *collaborator*, an IBM CAS *research staff member* and now I am a CAS *Visiting Scientist*. This article is about these four CAS roles that I consider the pillars of CAS. Since I spent most of the time as a Research Staff Member, I will focus mostly on that role, highlighting why it is important and the set of skills that makes that role successful. I also point out some major IBM driven IT events that I witnessed while collaborating with CAS.

### 1. INTRODUCTION

Established in 1990, the IBM Centre for Advanced Studies (or IBM CAS) has become a world-renowned collaboration model among industry, universities and the government research and funding institutions. In the world of innovation, there are many models to follow, but few are comparable with CAS in terms of efficiency, low cost, outreach and multitudes of outcomes. CAS, as any organization, owes its successes to many people working in or with that organization. Students and professors from Canadian, US or European countries, IBM software developers, managers or decision makers alike have contributed to IBM CAS's successes over the years. I am among the few lucky people who have experienced several roles in CAS: I was a CAS *student*, a CAS *collaborator*, a CAS *research staff member* and a CAS *Visiting Scientist*.

CASCON, or CAS CONference has started as the annual showcase for CAS and its collaborators and has become an international conference on computer science and software engineering.

In this chapter I describe my perspective on CAS and I focus on the four pillars at the core of its success. I will also touch upon some of CASCON events.

Copyright  $\bigcirc$  **2016** Marin Litoiu. Permission to copy is hereby granted provided the original copyright notice is reproduced in copies made.

## 2. CAS'S FOUR PILLARS

I will discuss the roles in the chronological order, as I experienced them.

## 2.1 CAS Fellowship Students

Many PhD or Master students learn about CAS from their supervisors and I was no different. I first heard of CAS while I was a fresh immigrant to Canada and a PhD student at Carleton University. At that time, I was looking for more industrial experience and I considered leaving the PhD program to take a job either with the Centre de Research in Informatique in Montreal, or with the National Research Council, in Ottawa. It was then that my supervisor, sensing the urgency, said: "IBM Toronto Lab has a research centre, Centre for Advanced Studies, where they carry on research with universities. That is a place for you." I did not know anything about this centre but it was in Toronto and it was IBM, so I could not say no to that. And so I became a CAS *student*. Since then, for 20 years this fall, my professional career has been intrinsically linked to IBM Centre for Advanced Studies.

In 1995, the CAS model was based on student internship embedded within development groups. It meant that students were part of a development group, they attended the group status meeting, and, "occasionally," they helped the development team with feature developments and unit testing. The student research project, meant to validate or extend his/her thesis subject, had to be relevant for that development group. IBM and the software group were in the midst of distributed systems middleware and Internet development. The industry and internet were transitioning from Remote Procedure Calls (RPC) to Objected Oriented Middleware (CORBA) to make the development of distributed systems look like that of the monolithic ones - that is classes, objects and messages. My research project focused on tracing and modeling the performance of distributed systems. There was a very tight integration between my research work and the development features plan. Figure 1 shows me, my development manager (Vito Spatafora) and the development leader (Bin Qin) demoing our joint research/development work at CASCON '97. They could explain and demo the project as expertly as me. While there were many technical aspects I learned from developers, the most important lessons were related to teamwork and communication within and outside the group. On the walls of the Lab, situated at 1150 Eglinton East, there were posters of the Beatles and other famous groups, as a reminder of how important the group work was.

The most memorable event from my student time at IBM was not related to my thesis or work but was rather adjacent. That was the time of IBM Deep Blue versus Kasparov chess matches. Growing up as a chess aficionado and mesmerized by the great champions, Spassky, Fisher, and Karpov, I cheered for Kasparov, hoping he would delay the inevitable, the dominance of brute force machine over man. I followed the games, the openings and the moves. My wish was not granted, Kasparov was defeated. Part of the coronation festivities, a less powerful Deep Blue computer was demoed at CASCON 97, and attendees got the chance to play against it. Nobody had a chance, even with that little machine. Since then, I gained interest in IBM but I lost my interest and love of chess.



Figure 1. CASCON 97 Demo. With the ADTC developers, Vito Spatafora and Bin Qin.

### 2.2 IBM Employees and CAS Collaborators

During my last year of PhD, I was offered a full time position at IBM (one of the outcomes of a CAS project) with the same group I was doing the internship. And so I started my second life in CAS, as an IBMer. The Centre for Advanced Studies was thought as a university-IBM collaboration place, with few full time IBM researchers but with many IBM developers acting as part time researchers. The role of the development group was first and foremost to initiate and champion CAS research projects and be the ultimate beneficiary of the research outcomes. It was understood that no CAS research project could succeed without the support of a development group. There were several reasons for that: the researchers from universities needed to understand the IBM software processes and products so they could ground their projects in the real world. Students needed technical mentorship and research partners while working on IBM Toronto Lab premises. For Lab software developers, a CAS project offered a chance to get familiar with the latest research trends, expand their creativity, get involved with CASCON by either co-authoring a paper, presenting a demo or giving a talk in a workshop. At that time, our development group,

Application Development Tools Centre (ADTC), was busy transitioning IBM software development tools from Visual Age to Eclipse. For the amateurs of software engineering history, IBM's first generation of visual tools was called Visual Age and it was developed in Smalltalk (see Figure 2 for a commemorative plaque). It was very hard to maintain and evolve the tools to keep up with the plethora of technologies and development needs arising just before the 2000 IT bubble. A leaner approach and plugging architecture was needed and that led to the open source Eclipse[6] that is known now to any software developer. While Eclipse was an IBM wide effort, IBM ADTC in Toronto was in charge of the distributed middleware support and later on with business development tools. Research questions around those technologies were transferred to CAS and research projects were initiated and carried out by several research groups over many years. Eclipse become known in Universities and used by students due to the CAS as well as University Relations efforts.

## 2.3 CAS Research Staff Members

I joined CAS as a Research Staff Member in 2000. The title "CAS Research Staff Member" (or RSM) was borrowed from IBM Research Division where the hierarchy is flat and everyone had the same title. However, the job description was different: a CAS RSM spent a big chunk of his/her time doing project and people management. Roughly, I spent 40% of my time doing research, 40% doing project and people management and 20% in committees, conference organization (including CASCON). This varied from month to month and made the life very interesting and rewarding, as I was not locked in one repetitive activity.



Figure 2. Visual Age for Java, first edition, written in Smalltalk. This paved the road to Eclipse.

As an RSM, I basically had freedom to organize my time, choose the university and IBM collaborators and initiate projects. There was a competition among RSMs for budget and projects and, at the time of funding decisions, we inevitably became competitive and our egos got bruised when the projects we supported were rejected. However, those small squabbles were quickly forgotten and there was a real sense of collegiality among all of us.



Figure 3. CAS welcomes the CAS fellowship students and the summer seminar series (scanned from IBM Log-on News).

A CAS RSM activity revolves around CAS projects and there were many projects each year. Figure 3 shows some of the students joining CAS in the summer of 2003, an indication of CAS activity size. During my time as CAS RSM, with few exceptions, all students were hosted in one open area. That created a CAS research centric environment (as opposed to development group centric) by allowing more interaction between RSMs and students (Figure 4) and among students (Figure 3 banner mentions the CAS summer seminars, hosted by students).

As an RSM I had to look both inward and outward. The IBM stakeholders (product and project managers, department managers, developers) who invested time and money in CAS wanted to see results: patents, smart features in their products, better skills and knowledge transferred to their groups, as well as new great graduates hired.

While CAS had a dedicated budget for projects and CASCON, that was only augmented with direct contributions from the development departments. Consequently, the project selection and funding decisions were done with input from the development groups, as was the continuous project evaluation. There was always a conflict between the academic and the industry timing. While the university researchers measured time in Masters or PhD thesis milestones, the software industry worked with quarters. Progress had to be shown quarterly and be substantial. I learned that this asynchronicity cannot and must not be tried to be solved; at most, it can be mitigated. It should be explained and reminded to both universities and development participants that they should not try to change each other's different worlds. Both parties should have the right expectations and mitigate the risks.



Figure 4. With CAS students in CAS open area: Marin Litoiu, Gerard Tarcisius, Faryaaz Kassam, Jenny Zhou, Maria Koshkina.

An RSM has to look outwards as well, write papers, present to and organize conferences, sometimes get involved in government policy or research committees. While these activities are not necessary and always recognized in IBM, they are sine-qua-non aspects that give credibility to CAS, IBM, and to RSM(s). I describe two major outward initiatives because CAS should be proud of them both.

### 2.3.1 CAS and Autonomic Computing Initiative.

One of the main outward initiatives I led in CAS was the IBM Autonomic Initiative. Started in 2003, at the corporate level, its goal was to motivate the university professors and students to tackle the complexity of software

management by starting projects and courses on Autonomic Software, which is software that manages itself. CAS was an influential actor in this and by partnering with IBM University Relations and IBM Autonomic Computing Division, we started with 2 projects in 2003 and reached 25 projects in 2005[7]. Autonomic computing has become a teaching subject in universities and a research subject since then. An offspring of autonomic computing initiative was the creation of the symposium for Software Engineering for Adaptive and Self-managing Software, SEAMS[3]. We

started it as a workshop, the Design and the Evolution of Autonomic Systems(DEAS), co-organized with CAS Visiting Scientists Hausi Muller and John Mylopoulos. The goal was to inject software engineering principles to the Autonomic Computing field. Later, DEAS morphed into SEAMS and is now in its 12<sup>th</sup> year. Another offspring was the Center for Excellence for Research in Adaptive Systems (CERAS), a research project started by IBM CAS and Ontario Centre of Excellence (Figure 5). This was the first large Canadian project looking into virtualization and cloud research. Other national projects followed, among them the Smart Applications on Virtual Infrastructure (SAVI) that would not have been possible without CAS support.



Figure 5. Marking the Creation of Centre of Excellence for Adaptive Systems (CERAS)

I highlight here the most important CAS research contributions in the autonomic computing field, contributions in which CAS and I played an important role. The contributions had impacted both IBM and academic community:

- Pioneering the use of control theory in tuning performance models. This work was conducted with Murray Woodside (Visiting Scientist), Tao Zheng (CAS student) and with Gabriel Iszlai (IBM developer). The first paper capturing the idea was published at CASCON 2005[4] and a string of other papers followed[8][18][20]. This work has won several awards, culminating with the Most Influential Paper of the Decade Award, at CASCON 2015. The ideas also led to an IBM patent, by the same researchers.
- Formalizing the composition and analysis of autonomic systems using control theory. I have done this work with Dan Ionescu (CAS Visiting Scientist), Bogdan Solomon (CAS student), Gabriel Iszlai and Mircea Mihaescu (IBM Developers) [13][12][15][9].
- Performance modeling of autonomic systems[10] and performance metrics extractions from source code. The latter involved Jim

Cordy (CAS Visiting Scientist), Nevon Brake (CAS student) and IBMers Valentina Popescu and Elisabeth Dancy [24].

## 2.3.2 CAS and Software Engineering Research in Canada

CAS can also claim its major influence in another major initiative in Canada that I chaired while I was a CAS RSM. It is the Consortium for Software Engineering Research (CSER), a research consortium comprising companies and universities. During the time I was the chair of CSER, IBM CAS funded most of CSER projects and also provided logistics and in-kind support. CSER involved many other companies and has been a model of precompetitive research. At the same time, both IBM and Canada software industry has benefitted from CSER, which provided a platform for training many generations of software engineers. Each year, CSER researchers have been the main contributors to CASCON events. Lately, CSER has evolved in a conference, collocated with CASCON.

Among the most impactful research I carried on with CSER researchers, I would like to mention:

- Business processes visualization and understanding. This work has been the result of a long collaboration with Peggy Storey (CAS Visiting Scientist) and CAS students Ian Bull, Derek Rayside [11][19][22][23].
- Architectures and design patterns for web service evolution, work with Hausi Muller (CAS Visiting Scientist) and Piotr Kaminsky (CAS student)[17][21].

# 2.4 CAS Visiting Scientists

Since I went back to my first life, of a professor, I had the opportunity to work with CAS as a Visiting Scientist, the forth pillar of CAS model. Seeing CAS from the other side, that of the University researcher gives me another perspective and a 360° view of university-industry collaboration. The vast experience CAS has in working with universities is mostly evident in its understanding of university research and in its processes developed around the win-win principle.



Figure 6. The CAS Project of the Year Award honours the CAS team that best epitomize the CAS mission statement. The recipients are members of the four CAS pillars.

From the project's inception and submission until the final stage of the project, the trajectory is as smooth as it can be. The intellectual property agreements, the first and major hurdle in a university-industry collaboration is already in place and agreed upon with most universities in Canada. This agreement elaborates on the ownership of newly created intellectual property, the freedom of publishing while at the same time protecting IBM confidential information. This contrasts with companies not versed in collaboration where it is often required to spend more than a year defining and signing an agreement. Also, CAS is very efficient in enabling access to IBM people, products and processes. Basically, as a Visiting Scientist you get physical and virtual access to the IBM Canada Lab and to IBM as a whole. While physical access was available from the very beginning of CAS, the virtual access to IBM in its entirety was created gradually to provide continuous project collaboration, easier sharing of software artifacts or access shared repositories. As an example of this transition, in my earlier days as a CAS RSM, if a student or a professor wanted to work on the project off cycle (outside the student four months' internship), we had to

ship an IBM computer to the university because, according to IBM internal procedures, "all development should take place on IBM owned computers." Besides giving virtual access to IBM, CAS also has a series of events that facilitate the interaction with IBM people. The most notable events are CASCON conference and the CAS University Days. While CASCON is known and available to a larger audience, the IBM CAS university days are meant for closer collaborators, IBM Visiting Scientists and Faculty Fellows and their students. Taking place over several days at IBM Toronto Lab, usually in May, those events allow for deep dives into research topics of interest to both IBM and university researchers, who share confidential information and establish future research priorities.



Figure 7. Receiving the "Faculty of the Year Award" from Bart Vashaw (Program Director, IBM). The award acknowledges the Faculty who had a lasting impact on IBM people, products and processes.

As I work with IBM CAS from the academic side, I notice the same organic collaboration I experienced as an IBMer. The research or practical accomplishments of the research projects are shared with CAS researchers and IBM developers. Below are some accomplishments I originated from the academic side but in which IBM CAS has a major role:

- Defining the architecture for hierarchical cloud optimization, work done with CAS researchers and other CAS visiting scientists[2], work for which we received the Best Paper Award.
- Cloud provisioning performance models, work done with Johnny Wong (CAS Visiting Scientist), Ye Hu (CAS student) Gabriel Iszlai (IBM CAS RSM) [16].
- Cloud services for management of Tools as a Service and the first deployment of IBM Rational Tools as a service in Cloud. This

accomplishment received the CAS Project of the Year Award (cf. Fig 6).

- Advancement of IBM research agenda on cloud computing for which I received the IBM Faculty of the Year Award (cf. Fig 7).
- Extended Kalman filters and particle estimators for multiclass software and business processes, with my CAS students Hamoun Ghanbari and Andrei Solomon and CAS RSMs Alex Lau and Gabriel Iszlai[14][25].

# 3. CONNECTING THE DOTS

Students, postdocs and colleagues who know my professional trajectory, often ask me the following questions: "Is it worth being a CAS student?", "Should I take an industry job and later return to university as a professor?" "Should I collaborate with industry?" One fallacy of posterior analysis is that one can connect the dots of the past in a nice story in which all the steps seem well choreographed and put together through a vision. Another fallacy is that, if the steps are being planned and choreographed, a professional trajectory must be repeatable. These fallacies apply to rare events[5] but mutatis-mutandis apply to professional careers narratives as well. Therefore, although I am hesitant to give definitive answers, I always emphasize both the pros and cons on making career choices.

A CAS fellowship and internship is an amazing opportunity for students who love practical things, do not have yet a strong industrial or practical experience and/or need practical case studies to validate their research. Maintaining permanent contact with development groups teaches communication and group dynamics while exposing the students to new technologies; however, it takes time and effort and might even slightly delay the thesis.

Choosing an industry job after getting a PhD when you are interested in University jobs is risk taking. Personally, I made that choice, I interviewed and declined academic positions and I took the IBM CAS RSM job, thinking that, if I wanted, I could apply for a faculty position later on. While it worked in my case and a few others, an industrial job will slow down the publication throughput, if not cut it completely. For some companies, publications are not an incentive; you might get yourself too busy with your release schedules, team dynamics and competition. There is a big chance you will never get back to a university professor job, unless you carefully manage your trajectory. However, if you succeed in your transition, you will have plenty of industrial and academic collaborators to work with and this is not a given in universities. On collaborating with CAS and industry in general I give a resounding yes, for many reasons. An industrial collaboration keeps you grounded, working on relevant problems, it gives you an opportunity to validate your assumptions. More importantly, students ought to know that they work on relevant research questions; many of them want contacts in industry to further their careers.

# 4. CONCLUSIONS

CAS is a proven collaboration model among university researchers and IBM. CAS owes its successes to many students, professors, IBMers and CAS staff members. I highlighted in this chapter the importance of the four pillars and I enumerated some of the CAS accomplishments in which I played a part. Definitely there are many more accomplishments and I hope other CAS members and collaborators will bring them to light. As we celebrate CAS' 25th birthday, I am happy and proud I have contributed to its growth and outreach and I hope the CAS model will live on for many years to come.

### ACKNOWLEDGMENTS

My many thanks go to IBMers who helped make CAS a success during my full time with IBM and with CAS: CAS managers Joe Wigglesworth, Gabby Silberman, Kelly Lyons, Joanna Ng gave me the freedom rarely seen in the corporate world; I had tremendous help from other CAS RSMs Julie Waterhouse, Jen Hawkins, Paul Smith, Terry Lau, Calisto Zuzarte, Robert Enenkel, Elena Litani, Stephen Perelgut, Marcellus Mindel (current CAS manager) as well as very strong support from IBM development and management leaders Kevin Stoodley, Bob Blainey, Arthur Ryman, Mike Starkey, Mircea Mihaescu, Tom Doucher, Alan Ganek, Jeff Kephard, Gabriel Iszlai, Andrew Trossman, Harm Sluiman and others. Visiting Scientists and CAS students made my days in CAS rewarding with fun and accomplishments: Johnny Wong, Hausi Muller, Peggy Storey, Murray Woodside, Dan Ionescu, John Mylopolous, Jim Cordy, Tao Zheng, Mike Smit, Bogdan Solomon, Brad Simmons, Ian Bull, Ladan Tahvildari, Jenny Zou, Kit Barton, Alex Duran, etc. In CAS, I also worked with many IBM interns who made my life enjoyable, Tom Plackson, Alexandru Litoiu as well as many staff members, Cheryl Morris, Brenda Chow and Debbie Kilbride. To all, and many others I forgot to mention, a big Thank You!

### 5. REFERENCES

[1] M. Litoiu, Hamid Khafagy, Bin Qin, Anita Rass Wan, and J. Rolia. 1997. A performance engineering tool and method for distributing applications. In *Proceedings of the 1997 conference of the Centre for Advanced*  *Studies on Collaborative research* (CASCON '97), J. Howard Johnson (Ed.). IBM Press

- [2] Marin Litoiu, Murray Woodside, Johnny Wong, Joanna Ng, and Gabriel Iszlai. 2010. A business driven cloud optimization architecture. In *Proceedings of the 2010 ACM Symposium on Applied Computing* (SAC '10). Best Paper Award, ACM, New York, NY, USA, 380-385.
- [3] Mylopoulos, J.; Litoiu, M.; Smit, M., Software Engineering for Adaptive and Self-Managing Systems (SEAMS), 2013 Proceedings on, vol., no., pp.iiiiv, 20-21 May 2013
- [4] Tao Zheng, Jinmei Yang, Murray Woodside, Marin Litoiu, and Gabriel Iszlai. 2005. Tracking time-varying parameters in software systems with extended Kalman filters. In *Proceedings of the 2005* conference of the Centre for Advanced Studies on Collaborative research (CASCON '05), James R. Cordy, Anatol W. Kark, and Darlene A. Stewart (Eds.). IBM Press 334-34 (Most Influential Paper Award of the Last Decade, CASCON 2015)
- [5] Nassim Nicholas Taleb, *The Black Swan*, The Random House Publishing Group, 2007
- [6] Eclipse open source, <u>http://Eclipse.org</u>, Sept 15, 2015.
- [7] Jeff Kephart, Autonomic Computing, the First Decade, Keynote at ICAC 2011, <u>http://www3.cis.fiu.edu/conferences/icac2011/files/Keynote\_Keph</u> <u>art.pdf</u>, Sept 2015
- [8] T. Zheng, C. M. Woodside and M. Litoiu, "Performance Model Estimation and Tracking Using Optimal Filters," *Software Engineering*, *IEEE Transactions on*, vol. 34, pp. 391-406, 2008.
- [9] B. Solomon, D. Ionescu, M. Litoiu "Web Service Distributed Management Framework for Autonomic Server Virtualization", in *Comp. and Inf. Scie, vol. 18,* Springer Verlag, 2008, pp 61-71.
- [10] Litoiu M., "A Performance Analysis Method for Autonomic Computing," ACM Transactions on Adaptive and Autonomous Systems (TAAS), Vol 2, No 1, pp. 1-27, 2007.
- [11] Rayside D., Litoiu M., Storey M., Best C. Lintern R., "Visualizing Flow Diagrams in WebSphere Studio Using SHriMP Views," *Information Systems Frontiers*, Vol. 5, No 2, pp. 161-174, 2003.
- [12] L. Checiu, B. Solomon, D. Ionescu, M. Litoiu and G. Iszlai,
  "Observability and controllability of autonomic computing systems for composed web services," in *Proceedings of the 6th IEEE International*

*Symposium on Applied Computational Intelligence and Informatics (SACI),* 2011, pp. 269-274.

- [13] B. Solomon, D. Ionescu, M. Litoiu and G. Iszlai, "Self-organizing autonomic computing systems," in *Proceedings of the 3rd IEEE International Symposium on Logistics and Industrial Informatics (LINDI)*, 2011, pp. 99-104.
- [14] H. Ghanbari, C. Barna, M. Litoiu, M. Woodside, T. Zheng, J. Wong and G. Iszlai, "Tracking adaptive performance models using dynamic clustering of user classes," in *Proceedings of the 2nd Joint IEEE/ACM* WOSP/SIPEW International Conference on Performance Engineering, 2011, pp. 179-188.
- [15] B. Solomon, D. Ionescu, M. Litoiu and G. Iszlai, "Autonomic computing control of composed web services," in *Proceedings of the* ACM/IEEE Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS'10), 2010, pp. 94-103.
- [16] Ye H., Wong J., Iszlai G., Litoiu M., "Resource Provisioning for Cloud Computing," *Proceedings of CASCON 2009*, November 2009, pp. 101-111.
- [17] Kaminski P., Litoiu M., Muller H., "A Design Technique for Evolving Web Services," Proceedings of ACM IBM Center for Advanced Studies Conference (CASCON 2006), ACM Digital Library, pp.211-222, Toronto, 2006.
- [18] Zheng T., Woodside M., Litoiu M., "Service System Resource Management Based on a Tracked Layered Performance Model," *Proceedings of IEEE International Conference on Autonomic Computing*, Dublin, Ireland, pp. 175-184, 2006.
- [19] Bull I., Storey M. A., Favre J. M., Litoiu M., "An Architecture to Support Model Driven Visualization," *Proceedings of the IEEE International Conference on Program Comprehension*, Athens, June, pp 100-106, 2006.
- [20] Woodside M., Zheng T., Litoiu M., "The use of optimal filters to track parameters of performance models," *Proceedings of IEEE International Conference on Quantitative Evaluation of Systems (QEST),* Turin, Italy, September 2005, pp 74-83, 2005.
- [21] Jun Ma, Holger M. Kienle, Piotr Kaminski, Anke Weber, Marin Litoiu, "Customizing Lotus Notes to build software engineering tools," *Proceedings of the ACM IBM Conference of the Centre for Advanced Studies (CASCON 2003), ACM Digital Library*, pp.211-222, October 06-09, 2003.

- [22] Derek Rayside, Marin Litoiu, Margaret-Anne Storey, and Casey Best. "Integrating SHriMP with the IBM WebSphere Studio Workbench," Proceedings of the ACM IBM Conference of the Centre for Advanced Studies (CASCON 2001), Toronto, Ontario, Canada, ACM Digital Library, pp.79-93, November 5-7, 2001.
- [23] Margaret-Anne Storey, Casey Best, Jeff Michaud, Derek Rayside, Marin Litoiu, and Mark Musen, "SHriMP Views: An Interactive Environment for Information Visualization and Navigation," *Proceedings of ACM CHI 2002*, Minneapolis, Minnesota, April 20-25, pp. 520-521, 2002.
- [24] Brake N., Cordy J., Dancy E., Litoiu M., Popescu V., "Automating Discovery of Software Tuning Parameters" Proceedings of Software Engineering for Adaptive and Self-Managing Systems (SEAMS 2008); 30th IEEE/ACM Software Engineering Conference on Software Engineering (ICSE 2008), 2008.
- [25] Solomon A., Litoiu M., Lau A., "Business Process Adaptation on a Tracked Simulation Model," ACM IBM Center for Advanced Studies Conference (CASCON 2010), November 2010, pp. 184-198.