



ICELANDIC INSTITUTE FOR INTELLIGENT MACHINES

EXECUTIVE SUMMARY

The Icelandic Institute for Intelligent Machines (IIIM) is a new institute structured specifically to catalyze innovation and high-technology research in Iceland. IIIM will improve progress in fields as varied as manufacturing, consumer products, bioinformatics, virtual worlds and games, energy and climate research, economic prediction, and policymaking, through a core focus on basic and applied research in artificial intelligence and simulation technologies. IIIM is funded through sponsorship from industrial and academic institutions, competitive research funds, technology licensing and ownership in spinoffs, and technology consulting. IIIM's industrial members provide challenging practical questions, while universities provide doctoral students, postdoctoral associates, and research faculty, as well as advanced research and knowledge. IIIM's three to nine-year development horizon for projects connects industry's typical two-year product horizon and the decade-or-more research horizon in academia, allowing industrial sponsors to more effectively plan their product development trajectories while enabling exploration of applied research problems in wider contexts. IIIM targets a 60/40 ratio between externally and internally-motivated research projects, producing basic research which not only stimulates progress in the sponsors' interest areas but also advances the fields of artificial intelligence and simulation. IIIM's funding, intellectual property and management schemes present a powerful framework for (a) exploiting synergies of input from a diverse set of institutions and companies to catalyze innovation, (b) supporting collaboration between parties from different industries, (c) increasing investors' return on investment in advanced research, (d) generating successful spinoff companies and (e) providing Iceland with a permanent, self-sustaining institute of innovation, research, development and education in advanced technologies that in the near future are poised to become as pervasive and value-generating as the personal computer.



A. OBJECTIVES

The Icelandic Institute for Intelligent Machines (IIIM) is a new institute structured specifically with the aim of catalyzing innovation and research in Iceland. IIIM will be Iceland's first independent research institution offering research in a subscription format. IIIM has chosen as its core focus the theoretical construction and practical implementation of two interdependent research topics, *artificial intelligence* and *simulation systems*, both of which are advanced technologies in growing demand around the world and poised to become pervasive and value-generating in the coming decades. As a result, IIIM is positioned to bring significant advances in automation, adaptive control and intelligent information management to a wide range of Icelandic industry leaders, promising to significantly improve their international competitive advantage. IIIM will stimulate progress in fields as varied as manufacturing, consumer products, bioinformatics, virtual worlds and games, energy and climate research, economic prediction and policy-making, through basic and applied research in artificial intelligence and simulation technologies.

IIIM's mission is to:

1. Create a self-sustaining, internationally-known center for innovation, development and research

IIIM will leverage the achievements and knowledge of world-class researchers, including four award-winning artificial intelligence (AI) researchers from Reykjavik University, leaders in their respective sub-fields of AI, from MIT, Stanford and U. Alberta. IIIM's Advisory Board includes founders and directors of related enterprises and activities, including the German Artificial Intelligence Center (DFKI) and the MIT Media Laboratory. The other academic participants are the Cognitive Interaction Technology Center of Excellence (CITEC) at Bielefeld University, University of Southern California and University of Strathclyde, both of which will be active in forming the direction and contributions of IIIM.

2. Significantly stimulate innovation in artificial intelligence and simulation technology and their broad fields of application

By bridging between academia and industry through a three to nine year horizon, IIIM will enable an efficient and targeted transfer of knowledge from academic laboratories to industry. The focus will be on projects and technologies that may be ready for use by industry, investors or spinoffs within three to nine years. Furthermore, bridging between industry's typical two-year product horizon and academia's decade-or-more research horizon gives participating companies a view into the future of their current product areas, permitting better strategic planning and opening a greater range of possibilities.

IIIM focus lies squarely in the software industry, which remains among the most important in the knowledge worker economy. In the U.S. alone, the top 500 software companies generated revenues over 390 Billion US dollars. Software is projected grow at a fast rate, continuing to be among the three fastest-growing industries over the next decade, according to Bureau of Labor Statistics at the U.S. Department of Labor.¹

Artificial intelligence (AI) research aims to increase the autonomy with which software and hardware systems can operate. It is a necessary ingredient for creating e.g., smarter factories, better artificial limbs, more effective remote communications, smarter search and data analysis, and better human-computer interaction. According to the Japan Robot Association, the world market for robots alone will reach around 50 Billion Euros by 2025². Behind such robot hardware lies of course intelligent software with great potential to grow in complexity; it does not take a leap of imagination to see the potential in revenues generated by advances in applied artificial intelligence, based on these numbers. When we factor in the recent exponential growth of information, calling for ever smarter mechanisms to filter, search, understand and analyze the enormous amounts of information available on the Internet every year, it is clear that AI technologies will see an exponential increase in opportunities for revenue generation in the coming decades.

1 Applications Go Worldwide. John P. Desmond, *The Software 500*, Oct. 2007. <http://www.softwaremag.com/L.cfm?Doc=1085-10/2007>

2 Summary Report on Technology Strategy for Creating a "Robot Society" in the 21st Century. *Japan Robot Association*, May 2001.

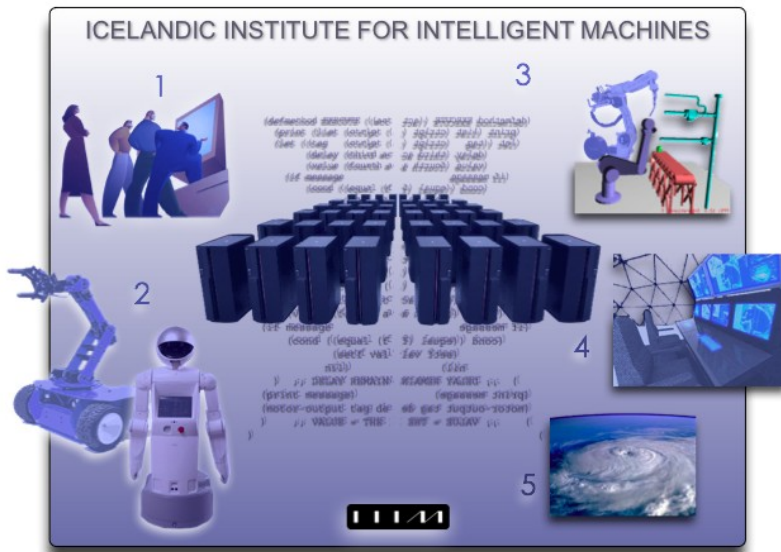


FIGURE 1. IIIM will build powerful hardware/software platforms (center) for advanced research in artificial intelligence and simulation, supporting the development of products and technologies with common needs such as 1: powerful new programming and visualization methods for developing large, complex software systems; 2: software for intelligent, interactive robots in complex environments; 3: simulation of manufacturing plants for testing advanced AI systems; 4: modeling and monitoring of complex dynamic processes; 5: simulations of complex natural phenomena, using advanced simulation and AI technologies.

Simulation technologies are key to developing understanding of many complex phenomena, including economies, natural resources, weather systems and climate change, manufacturing processes, and the phenomenon of intelligence. The AI/simulation combination is sufficiently narrow to provide IIIM a clear focus while being sufficiently broad to encompass a wide variety of projects, people and subscribing companies, which will provide opportunity for unprecedented cross-pollinations of research problems from different industries.

Within the fields of AI and simulation, IIIM will focus upon the following four areas which are poised to produce strong theoretical and practical results within the next two decades:

- Holistic Adaptive Architectures
 - Theory: The necessary precondition for all higher-level intelligence.
 - Applications: Simulations of complex systems and specialized humanlike faculties such as face recognition systems, object recognition, etc.
- Sensor-Actuator Loop
 - Theory: The fundamental connection between sensors and actuators that enables intelligent beings to stay alive and act in the real world.
 - Applications: Sensing/response systems which must work in real-time, e.g. artificial limbs, factory robots, etc.
- Communication and Understanding
 - Theory: The primary forces behind culture and human-like intelligence.
 - Applications: Human-computer interaction, computer-mediated human-human interaction, online communities and virtual worlds, economic simulations, simulations of the behavior of large groups, etc.

3. Provide industrial participants with tangible returns

IIIM's industrial Founding Members have a common interest in bringing advanced software solutions to their products, manufacturing process and management activities. The operational model of IIIM, which is already proven in Germany and the U.S., brings advanced technologies to its industrial members faster and more reliably than is possible with direct collaboration between academia and industry. Furthermore, bringing research projects related to a diversity of applications under one roof, with the common themes of automation and improved handling of complexity, will facilitate unexpected cross-pollinations and promote new advances.

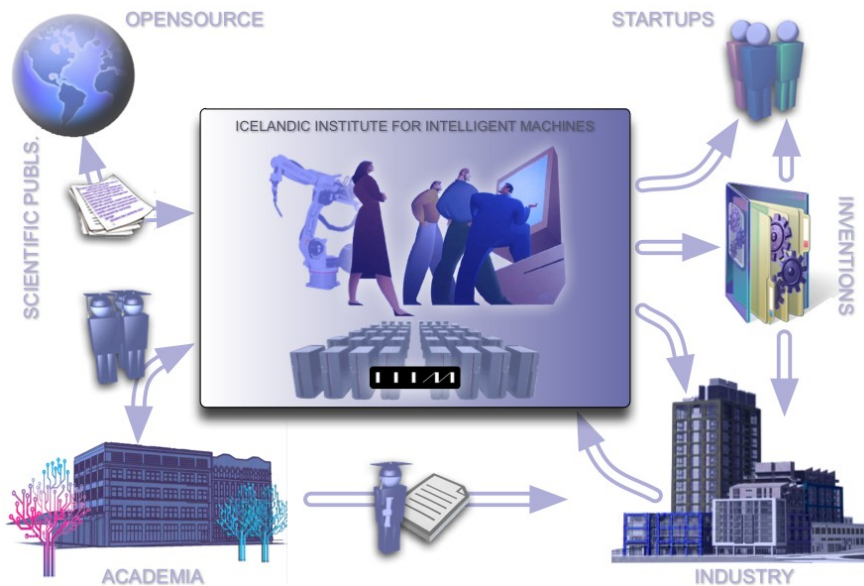


FIGURE 2. Through its unique sponsorship/ subscription scheme and intellectual property agreement, IIIM will facilitate highly dynamic interactions between academia, industry and investors in a way that is difficult to achieve in any other way. Flow of people, ideas and prototypes between IIIM and academia and industry will create new opportunities for innovation and investments.

4. Generate spinoff companies

The German Artificial Intelligence Research Center (DFKI), a non-profit research organization largely identical to IIIM, has produced over 43 successful spinoffs in 20 years of operation – a rate of over 1.6 successful spinoffs per year. We aim to achieve comparable results with IIIM. To help with this venture capitalists are among the Founding Members of IIIM. Furthermore, key startup incubators in Iceland will work closely with IIIM to develop spinoffs.

5. Facilitate collaboration between US and European researchers

IIIM's funding model allows researchers from different continents to more easily come under one roof and work together. Situated in Iceland, IIIM is ideally placed for academic and industrial collaborations between the United States and Europe. Culturally, Iceland shows both US and European influences. The small Icelandic society consists largely of early adopters of technology, making it a unique testbed for innovations in which economic and social impacts of innovations are quickly and readily observable. IIIM will be a convergence point for universities and companies heretofore isolated by geography, bureaucracy and methodology. In keeping with this goal, IIIM's academic Founding Members are from Iceland, US and Europe:

- **Reykjavik University** runs the largest computer science department in Iceland.
- The **Intelligent Systems Division of the Information Sciences Institute (ISD/ISI)** at the **University of Southern California** is a world leader in artificial intelligence topics including semantic web, language technology and adaptive robots.
- The **Department of Computer and Information Sciences** at the **University of Strathclyde, Scotland** has a focus on automation and industrial applications.
- **Cognitive Interaction Technology Center of Excellence**, Bielefeld University.

6. Generate and keep high-technology industry in Iceland

IIIM will facilitate brain gain in Iceland by developing and then providing places to employ local knowledge and initiative. A local high-technology industry serves as an economic basis which produces value for the Icelandic society, in contrast to exportation of Iceland's natural resources to foreign countries where they are processed for the benefit of others' economies. IIIM will develop an effective system of curatorship of its public and private projects, ideas, and technologies in order to facilitate reuse of tools and continuation of project ideas over time. IIIM will also hold tutorials of its publicly-released technologies for the Icelandic public.



For the first time in Iceland, one roof will house projects related to a diversity of industries, potentiating otherwise unlikely cross-pollination. IIIM will serve a role that cannot be filled in other ways by ensuring:

- Conceptual overlap between research projects.
- Increased levels of coordination between projects.
- Active invention of standardized and unifying integration technologies.
- Targeted, organized information flow between all parties.
- Attraction of research funding through flexible combinations of partners, topics, researchers and technologies.
- Targeted effort to bring research projects from academic labs and into the hands of the industry.

IIIM is unique in the world in its proposed methods for bridging between industry's typical two to three year product horizon and academia's ten-to-infinity year research horizon. An early mix of academia and engineering on project pipelines will ensure reuse of code throughout the nine-year development horizon of IIIM. Methods, algorithms, and partial code developed at IIIM may be used freely by its sponsors at any point in the development pipeline. IIIM will enable the productizations of technologies which all too often never come out of academic laboratories. Not only will IIIM greatly strengthen current research activities in Iceland, IIIM promises to vastly improve the possibilities of spinoffs and new enterprises through an active effort to identify new opportunities, markets and people.

IIIM will bring to Iceland several new research projects with international collaborators, and progress on foundational technologies which have been developed in the Center for the Analysis and Design of Intelligent Agents at Reykjavik University and affiliates, which would otherwise not occur without IIIM's existence.

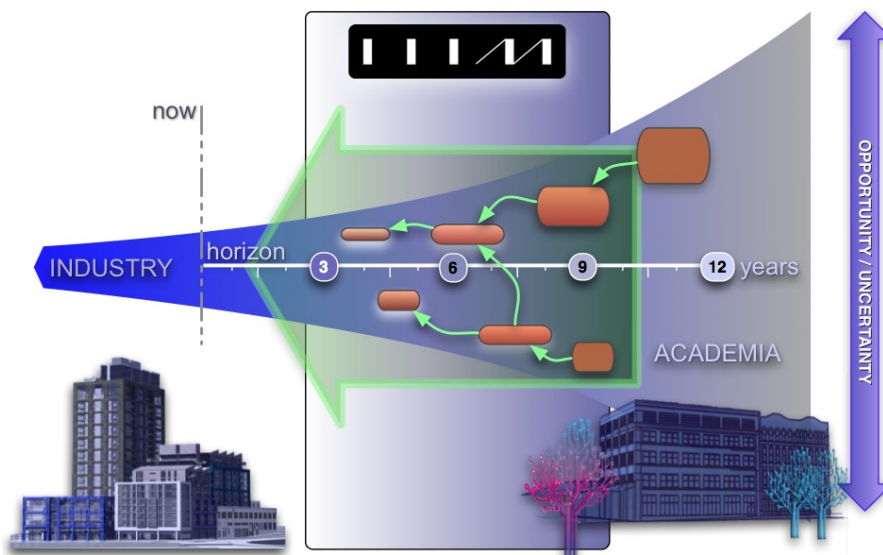


FIGURE 3. IIIM will bridge between academia and industry, enabling academia to better relate to industrial needs, at the same time allowing industry to benefit sooner from academic results. The 3-year horizon of most product development in industry ("3", left-hand side) is met with IIIM's 3-9 year horizon, connecting with the most advanced products on the industrial side with the further-reaching horizon of academic projects ("9", right-hand side), at one decade or more into the future. IIIM's activities are thus aimed at moving advanced, forward looking projects more quickly through a development process (large arrow) that takes into consideration the needs of industry, taking them through a process of refinement (boxes with arrows) until they are ready to be used for the development of products.