

Five Years of Industrial Informatics: Towards Holistic Industrial Ecosystems

The development of industrial informatics along the five years since the first INDIN Conference was marked by many tumultuous transformations in the information and communication technologies (ICT) domain, which are radically and rapidly changing our world. The initial vision [1] has materialized in that, on the informatics side, eNetworks [2] are the pervasive infrastructures supporting industrial development in the global village of our networked world. An eNetwork integrates computing, communication, and storage capabilities with the monitoring and/or control of entities in the physical world and must do so dependably, safely, securely, efficiently, and in real time. During our efforts to start *IEEE Transactions on Industrial Informatics* [1] we were wondering if the industry is prepared for a new paradigm with strong information processing content (the “informatics” ingredient in the INDIN recipe). Today we witness how eNetworks connect global enterprises in holistic digital ecosystems of networked manufacturing (eManufacturing) in which autonomous eServices cohabit harmoniously within the synchronous production workflow managed via eLogistics [3]. In the past five years, industrial informatics coevolved in synch with the ICT developments as progressively marked by the annual conferences of this growing community, with each INDIN Conference adding a new dimension to the ever growing industrial informatics picture.

In 2003 under the “eLogistics for a Fail-Safe World,” we positioned industrial informatics at the lead of and endowed it with the responsibility for designing resilient and robust products and processes, on the foundation of breakthrough developments in the informat-

ics dimension, with the novel distributed intelligence paradigms emerging at the time. We aimed at the development of processing technologies with the ability to respond quickly to changes in the market as well as in society, seeking the best ways to cope with the dynamics of our fast-paced world, including the unprecedented threats that mutated mankind’s societal and economic course with unfortunate disruptions at the beginning of the new millennium. Thus, security and safety were positioned at the forefront of industrial informatics, mirroring their emphasis in the ICT domain. The latest trends in the industrial dimension were taken to new heights by INDIN 2004, which proposed the vision of intelligent industrial environments. With origins in the holonic enterprise paradigm [4], the OOONEIDA concept (<http://www.oooneida.info/index.html>) deepens the industrial dimension through the creation of intelligent, flexible manufacturing environments materialized today in the emergence of digital manufacturing ecosystems in which collaborative automation is the only way to thrive and progress in the global knowledge economy. The business dimension

has been added by INDIN 2005, underlining how essential ICT became in successfully running the industrial process, thus pushing the frontier of the industrial ecosystem to coevolve with the market demand. And the fourth dimension, integrating services into the manufacturing ecosystems, was added by INDIN 2006. Thus INDIN 2007 takes over a holistic industrial ecosystem emerging in a networked world, which integrates the four dimensions of industry, ICT (informatics), business, and services.

This calls for new paradigms to enable the seamless creation of manufacturing ecosystems that evolve and adapt in tune with the market dynamics to enable the controlled sharing and management of information over the Internet and industrial networks critical to the effective planning, coordination, and execution of activities and the movement of materials/services through the value chain to address the various stages of today’s product or service life cycle. With the premise that progress in industrial informatics will mirror the paradigm shifts in networking and communications, in the sequel we will dare to anticipate the major trends in the dynamic interplay of distributed intelligent technologies and services driving tomorrow’s complex and converging interdependent ecosystem of a networked world while pointing to how and where will it take the industry.

Where the Future Lies: Holistic Industrial Ecosystems

The future Internet is envisioned to leap towards a radical transformation from how we know it today (a mere communication highway) into a vast hybrid network seamlessly integrating physical (mobile or static) systems to power, control, or operate virtually any device, appliance, or system/infrastructure. Manipulation



Passing the torch: Mihaela Ulieru, general chair and organizer of the first INDIN (August 2003, Canada) with Dietmar Dietrich, general chair and organizer of the fifth INDIN (July 2007, Vienna, Austria).

of the physical world occurs locally, but control and observability are enabled safely and securely across a (virtual) network. It is this emerging hybrid network that we refer to as an eNetwork. eNetworks enable the spontaneous creation of collaborative societies of artifacts, referred to as “cyber-physical ecosystems” [3]. In such opportunistic ecosystems, single devices/departments/enterprises become part of a larger and more complex infrastructure in which the individual properties or attributes of single entities are dynamically combined to achieve an emergent desired behavior of the ecosystem. Collaborative systems will be the norm, demanding industrial systems to adapt to each other thus orchestrating complex behaviors [6] by embedding control features within modules such that their properties can be exploited in a variety of application-specific ways. Change will be a constituent property in eNetworks enabling the emergence of autonomic digital ecosystems from individual building blocks of the future production systems.

A task as ambitious as the development of the eNetworks that will animate the future industrial ecosystems cannot be accomplished in isolation. A vital part of this effort concerns fostering collaboration and consensus building among researchers working on future global network architectures, who share like-minded visions. The

new Emergent Technologies Task Force of the IES-TC on Industrial Agents has the mission to interface with the major initiatives in Europe (EU-FET Future Internet Research and Experimentation, FIRE), the United States (NSF NETS research program on Future Internet Network Design, FIND), and Canada (CANARIE Inc., Canada’s advanced Internet development organization) who drive the development of tomorrow’s networked world to keep up with and exploit breakthrough findings enabling industrial informatics to sustain and support mankind in facing its future challenges.

In the search for paradigms and models that will help us to best exploit the enormous potential unleashed by eNetworks in the industrial world, we may have forgotten to look in the mirror to ourselves as source of inspiration. Is the brain as a dynamic network of networks on which the mind’s foundation emerged, too obvious to be noticeable in this race? Not for everyone! And here is the Foresight “spice” that the INDIN 2007 organizers bring to the picture through their daring attempt to look into the mysteries of the human mind for novel engineering and industrial paradigms. The First Engineering and Psycho-analysts Forum (ENF 2007) to be held in conjunction with INDIN 2007 poses a visionary, highest-level challenge to the

INDIN community: can we not only decipher the mysteries of human mind but also of the human spirit? And if yes, then can we use the code to animate machines? The ENF paradigm shift will take industrial informatics to new heights in the future and the INDIN community is already setting the stage for this challenge with the theme of INDIN 2008, which aims to harmonize computers, machines, and people. With excitement and delight we witness what we anticipated in the initial vision [1], the addition of the multidimensional human factor to the industrial ecosystem. With this, a new saga driving industrial informatics in the second half of its first decade is about to start.

References

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2007 IEEE International Symposium on Industrial Electronics

IEEE ISIE 2007 in Vigo: Success Goes One Big Step Beyond

The 2007 IEEE International Symposium on Industrial Electronics, ISIE 2007, was held from 4–7 June at the Centro Cultural and Centro Social Caixanova, Vigo, Spain.

ISIE 2007 has been the largest of all ISIE editions held up to now, with nearly 1,000 high-quality papers submitted (300 to special sessions) from 62 countries. The new IES automatic reviewer assignment system was successfully used for the first time, eas-

ing the coordination of the work of some 1,580 reviewers. There were 609 papers accepted, which yields an

acceptance rate of about 60%. The final program consisted of 97 technical sessions, organized in seven tech-



Welcome and opening remarks.