Ubiquitous Computing and Communication for Product Monitoring

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INTRODUCTION

The present discussion summarises the benefits provided with resort to IT instruments, by dealing with the delivery of *extended* artefacts, under the responsibility of *extended* enterprises. In view to establish the IT environment, one needs to address the market paradigm-shift, from earlier commodity- to mainly utility-based economics, having supply chains concerned by *products-services*, where the latter delivering often outruns the former. Outstripping the pertinent material flows, effectiveness quickly turns on the information flows, supported by networked organisations and cooperative set-ups, with mainly, a twofold outcome: (1) value added in totally new provisions, enhancing the supply effectiveness; (2) value added to the joined information and related transparency of overall environmental impact.

Ambient intelligence is technology-driven opportunity based on the user friendly exploitation of ubiquitous computing and communication (Riva, Vatalaro, Davide, & Alcañiz, 2005; Stephanidis, 2001; VanLoenen, 2003). Turning ambient intelligence toward collaboration activities and eco-compatibility certifying duties could be the winning option to support enterprise competitiveness, privacy protection and eco-system safeguard through cooperative organisations. The involved IT aids basically will move from the existing World Wide Web capabilities, enhancing the *extended* enterprise, with the qualifying functions of service engineering, and fitting out the on-duty incumbents by users' adaptive interfaces.

BACKGROUND

The IT options grant new prospects, as for manufacturing and market organisation, leading to new traded items, *products-services* or *extended* artefacts, by means of new industrial set-ups, the *networked* facilities. Indeed, the recalled concepts lead to address the ambient intelligence and the supporting IT processing Web options for enterprise cooperation and business deployment according to an innovative scenario to grant competitive advantage of richer or enhanced delivery with lifecycle transparent eco-conservativeness. This scenario corresponds to a shared vision aiming at development sustainability based on key aspects (Figure 1) where product on-duty properties and enterprise point-of-service responsibility are transparently reported, assuring the eco-impact data management under third-party certification.

The information set-up consistent with the sketched scenario faces two conditioning lines:

- technical feasibility incumbents, which can be dealt with by suitably implemented IC innovative aids;

Figure 1. Key aspects of the information frame for sustainability

• ***extended enterprise co-operative environment***, the net concerns operate with unified responsibilities, under headquarters ruling the traded provisions on their lifelong span;
• ***product-service unified data-frame***, the delivery of ***extended*** artifacts is primary achievement, and on-duty visibility is basic knowledge, to keep conformance-to-specification levels;
• ***total connectedness***, all authorized stakeholders are linked by communication infrastructures that deliver the right data at the right time, according to their permit and priority labels;
• ***supply-chain transparent reporting***, business productivity gives account, out of finance and lobar factors, also technology and natural resources (e.g., by the ***KILT*** model);
• ***eco-impact data management***, the entropy trend is monitored on the ***extended*** artefacts span, and assessed by acknowledged standards (e.g., the ***TYPUS*** metrics);
• ***third-party certification data-vaulting***, accredited bodies oversee downgrading on the ***extended*** artefacts, lifecycle, and charge consumers for the net natural capital depletion.

- politico-legal and socio-economical hindrances, which will evolve with sustainability consciousness.

Along the first line, the technical literature (Abowd, 2004; Ailisto, Kotila, & Strömmer, 2003; Ameri &Dutta,2004; Dekker & Scarf, 1998; Garetti, 2004; Michelini &Kovacs, 2005), deals with the networked infrastructure technology, namely, the IT aids that need be added to the supply chain for lifecycle management. These are enabling support of product data visibility and eco-consistency assessment, once politico-legal and socio-economical pertinent rules are established. The coherent description of the product impact, over the operation horizon, including reverse logistics, needs address the consumable decay, explicitly making account of involved natural resources.

The approach leads, for instance, to the *KILT* model (Michelini, Acaccia, Callegari, Molfino, & Razzoli, 1999; Michelini & Razzoli, 2004a, 2004b) linking the delivery, ***Q***, of the manufacture activity to the four inputs corresponding to all contributed capitals, say:

- ***K***, *know-how* or *technical capital*, the knowledge and technology exploited in manufacturing,
- ***I***, *invested financial capital*, traditional driving input of earlier industrial economical set-ups,
- ***L***, *directly engaged labour*, conventional work-force counterpart of industrial organisations,
- ***T***, *natural capital*, actually consumed tangibles to support the whole actual supply chain.

Return on invested capitals is built on all factors, and fair competition requires *equal opportunity* players, compelled:

- to bring out the dependence on tangible resources consumption ***T***, when pricing items;
- to equitably remunerate the direct labour ***L***, along the product-service supply-chain, dismissal included;
- to repay the fixed assets ***I***, for the share- and stake-holders profits;
- to exploit the underlying knowledge ***K***, both enterprise solid practice or non-proprietary technologies.

COOPERATIVE ORGANISATION FOR LIFE-LONG SERVICE

The earlier outlined scenario is consistent with new supply chains, delivering *products-services* supported by cooperating organisations. The changes open new business paradigms, based on product lifecycle management (Ameri & Dutta, 2004) and service engineering, embedding high-intensity information flow with intangibles value added and enhanced transparency of natural capital exploitation. These paradigms (Figure 2) encompass three layers: the business *networked concern*, the *extended* artefacts delivery layout, and the *certified visibility* set-up; the IT tools differ, as the horizons broaden, to include clients and controllers.

The manufacturer business concern has to deal with all layers, especially today, as the supplier responsibility expands to cover lifecycle conformance-to-specification prerequisites and dismissal requirements out of the *point-of-sale*. The *point-of-service* tasks address items operation properties on two facts: on-duty reliability for users' satisfaction and eco-impact control for environmental protection. This leads to widely expanding the domain of intervention of existing corporations with new tasks out of traditional workshops based on competencies up until new not dealt with, and mostly covered by providers timely taken in by users after the *point-of-sale*. The social interest of third parties, in environment protection and natural capital preservation, is new fact, entitling governmental regulations explicitly involving who conceives and brings out the traded goods. Then, the efficient answer brings to *extended* enterprises with the new business paradigms of *product-service* delivering.

Thereafter, the *service engineering* (SE) will appear as challenging duty, linked to the design steps by the *product-lifecycle-management* (PLM) for accessing the technical sheets for *point-of-service* and *point-of-dismissal* tasks.

Figure 2. Collaborative networks for lifecycle visibility

- The networked organization, granting the information service for customers, is required:
  - # to provide collaborative forms and behaviors for product life-cycle management;
  - # to rule conformance assessment and restoration within networked responsible bodies.
- The *extended* enterprise profits of a networked organization to expand buyers satisfaction:
  - co-operative design and shared knowledge make multi-technology *extended* artifacts possible;
  - lifecycle data pricing becomes relevant and *new* competition feature between companies.
- The sustainability assures *fair* trade conditions, provided that networks are available, in order:
  - to employ objective, world wide referenced, metrological standards (e.g., *TYPUS* metrics);
  - to record the artifact lifecycle behavior, controlled by independent certifying bodies.