Foreword

A supply chain is a complex system composed by organizations and people with their activities involved in transferring a product or service toward a final customer. The key to make a successful supply chain relies on an extended collaboration, implying the integration among actors involved in the productive and logistic network. An integrated and flexible management of production and logistics (physical and information flows) has to be set-up both inside and outside factory boundaries. Specialized production and distribution processes suffer from the limited interaction allowed by rigid networks. As a result, nowadays a relevant component of competition in the market occurs among information chains. The supply chain can no longer be represented as static or linear, but it needs to be evaluated dynamically, as a complex system made of interactions and connections among actors operating along the chain itself.

Many empirical investigations have demonstrated there is a positive correlation between enterprise performances and its propensity and attitude to be integrated into larger systems. This is the reason why enterprises are more and more attentive to the opportunity offered by both coordination and cooperation among their internal functions and the other external actors contributing in different ways to the business. Hence, information has been an increasingly strategic asset in the last few years. It covers a determinant position in manufacturing, logistics, and marketing. The physical flow of raw materials, products, and their related information is considered a strategic element for quality standards of products/services, for business analysis and evaluation, and finally to allow corrective actions. In particular, current trends in the consumer products market assign a growing significance to smart production chains. The even more increasing dimension of manufacturing groups –mostly due to the reached degree of decentralization of production- makes them privileged centers of value accumulation, acting as sources for the information flow for the whole chain. As a result, the main manufacturers are investing in new technology in order to boost the information exchange and are mandating the adoption of interoperable solutions to commercial partners.

In general, the Ubiquitous Computing (UbiComp) paradigm favors the pervasiveness of information in a given context. As originally introduced by Mark Weiser, UbiComp requires both information and computational capabilities, which are deeply integrated into common objects and/or actions and the user will interact with many computational devices simultaneously, exploiting data automatically extracted from “smart objects” permeating the environment during her ordinary activities. In addition, AutoID (Automatic IDentification) technologies play a relevant role in creating a virtual counterpart to physical objects. Because of their features, they provide better levels of automation in the product chains and help prevent human errors.

However, a more advanced exploitation of the very large amount of data now put at one’s disposal by the permeation of identification technologies in the production processes is strongly required. The
trivial one-to-one association between the physical and digital worlds restrains a powerful adoption of such data wealth. Massive data extraction and analysis is quite difficult without the support of proper management and aggregation schemes. Concrete improvements in information-enhanced production and supply chains rely on global trend inspections over the chains themselves, which require multidimensional analyses of huge amounts of data generated and stored in central DBMSs. Serious data management issues are then inevitably inherited and must be faced.

Hence, innovative models are required not only to let information permeate a manufacturing system, but also to leverage the derived informative asset in a fruitful way. By exploiting a distributed architecture, a unified framework should enable both quick run-time analyses (with respect to a local fragment of the overall information thesaurus) and stand-alone massive business logic elaborations (with respect to a centralized DBMS) following needs and requirements of the supply chain actors.

Noteworthy, it should chase the possibility to add semantically rich and unambiguous information able to follow a product in each step of its life cycle. Such a manufacturing model could allow manufacturers to trace and discover the information flow—associated to products thanks to their embedded informative counterparts—along the supply chain. Different analyses could be so formalized (e.g., product-centric, node-centric, path-oriented, time-oriented). Exploiting proper queries, product and process information could be read, updated, and integrated during manufacturing, packaging, and distribution, thus allowing full traceability up to sales, as well as intelligent and de-localized interrogation of product data. Several tangible (economic) and intangible benefits are expected. During product manufacturing and distribution, a wide-area support network interconnecting commercial partners is not strictly needed: this is a significant innovation with respect to common management solutions. A structured and detailed description of product features, allow goods to auto-expose their description to any computing environment they reach. This favors decentralized approaches and enables context-aware applications, based on less expensive and more manageable mobile ad-hoc networks. In addition to improved traceability, a smart manufacturing and distribution system hence provides unique value-added capabilities.

This book addresses modern problems affecting supply chains and manufacturing systems from the perspective of innovation and transformation. Nowadays, specialized production and distribution processes suffer from the limited interaction allowed by old rigid networks. As a result, a relevant component of competition in the market occurs among information chains. Smart solutions, novel approaches, and technical and technological enhancements are seen as a means to overcome most common drawbacks in systems and infrastructures—such as the manufacturing ones—having a long and entrenched history and classically being resilient to modernization and evolution. The book envisions interconnection and intelligence as two fundamental elements to be pursued to boost the innovation and transformation of manufacturing systems. The key to make a successful production and distribution chain must be researched in an extended collaboration, implying the integration among actors involved in the productive and logistic network. A flexible management of production and logistics (physical and information flows) has to be set-up both inside and outside factory boundaries.

The book explains that a relevant aspect of a smart production chain is the information sharing, which allows the optimization of actions and the improvement of performance both in terms of provided features and by enabling innovative services available for all involved actors. The envisioned production schemes can support a range of use cases, for different stakeholders along a product life cycle. The coherent development of smart manufacturing models allows a strengthening of the information to be shared between the actors involved in production chains, reducing the costs of adoption of technology in
business. Furthermore, an increase in transparency and trust is achieved not only between supply chain partners, but also between retailers and customers.

The book is organized twelve chapters; they were carefully selected to provide a wide scope to the general theme of the book with minimal overlap to reduce duplications. Each contributor was asked that his/her chapter should include a state-of-the-art survey as well as ongoing developments. Most promising approaches in the field of innovation of manufacturing system were so selected and brought together to evidence a fundamental aim that such allowed interconnection may be a direct competitive advantage for companies that adopt the technology.

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