

# **Intention-based Configuration of Information and Communication Components for Industry 4.0 Applications**

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## **Abstract:**

This PhD thesis is a cross-fields research project between Information Systems (IS) architecture and Distributed Systems Computing applied to Industrial Industry 4.0 applications. It encompasses Computing, Storage and Networking for Internet of Everything like applications with a business delivery orientation. The aim of our proposal is to adapt dynamically the supporting infrastructure to evolving business requirements through the organizational IS architecture. The adaptation will be made using a situational approach [1] allowing to establish and to maintain the link between ICT components and business strategy by introducing an intentional layer.

## **Description:**

Nowadays, organizations move forward the digital transformation. They are challenged by new Information and Communications Technologies (ICT) such as Industrial Internet-of-Things and Artificial Intelligence based Applications, Cyber-Physical Systems, Blockchain, 5G Networks, and so on [2]. Industry 4.0 (I4.0), commonly referred to as the fourth industrial revolution, is about the current trends of automation and data exchange in manufacturing technologies [2]. Digitalization and Industry 4.0 are profoundly changing society, economy and the way businesses operate. To face these challenges, organizations design and implement new business and Information Technology models based on Distributed Systems to guarantee that the company will reach the objectives defined by new opportunities and limit any threat of an unfavorable environment.

Numerous research works are conducted to study the impact of these digital technologies on enterprise management, for instance, within the Business-IT Alignment [3] or Enterprise Architecture [4] fields. However, there is a lack of alignment of Industry 4.0 ICT to the business strategy and business goals. The existing literature still does not respond to this compelling and deep need. For instance, the most known framework dealing with it is the "Reference Architectural Model Industrie 4.0" (RAMI 4.0), proposed by the Standardization Council Industry 4.0 (SCI4.0) [5] [6]. It defines a three-dimensional framework to structure and define Industry 4.0 components. Even if one of the axes of this model includes the business layer, it is reduced to organization and business processes. This lack of a powerful alignment metaphor is a weakness of RAMI 4.0 proposal and of the other existing approaches. The lack of alignment induces less efficient distribution of resources, less adapted configuration, lower level of business goals achievement and of adaptation to the context.

The research problem we want to address in this PhD thesis proposal is related to these weaknesses. From our point of view, a completely new approach should encompass both business strategy and digital technologies deployed to support it through an intentional perspective. The notion of intention is essential for organizations as it allows requirements of internal and external users of ICT to be satisfied. The teleological (intention-oriented) perspective gains traction in many fields including different organizational aspects as it allows artifacts under consideration to be connected to business and other needs [7]. For example, Intent-Based Networking is an emerging approach allowing the configuration of the physical and virtual network infrastructure depending on business strategies requirements [8].

The intention-based conciliation approach would provide means for a context-aware adoption and configuration of underlying digital technologies. Corresponding to this assumption, we propose to apply approaches issued from the field of Situational Method Engineering (SME) [1] [9] [10]. SME aims at building methods adapted to concrete situations from a set of reusable method components depending on the context factors. Several approaches exist: assembly, extension, configuration and so on [9]. One of the approaches is based on software product lines and develops a family of methods based on variability [1]. During the application, the family is configured accordingly to a given context and to the users' intentions [10]. Applied

to this PhD project at hand, components should be defined at the level of ICT components and the family at the level of the infrastructure.

The research goal of this PhD project is to provide an intention-based approach to ease the integration of new ICT into organizations dynamically during all the Information System lifecycle. Organizations would be able to adapt and to stick, as quickly as possible, to business requirements changes. The work on this thesis includes:

- Preparation of a State-of-the-Art on intention-based approaches in ICT and their adoption by organizations,
- Formalization of the concept of a reusable ICT component allowing its contextual configuration,
- Elaboration of the ontology of intentions adapted to the usage of ICT components,
- Elaboration of a framework allowing to relate ICT components to business strategy through the intentional layer,
- Proposal of an approach for the contextual selection and configuration of ICT components including the selection of the appropriate technique to bring this ability to adapt the architecture of the applications and the underlying technologies.

**Keywords:** Digitalization, Industry 4.0, Intention-based Approach, Distributed Systems, Situational Method Engineering

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