

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 maintain the link between ICT components and business strategy by introducing an intentional layer.

Description:

Nowadays, organizations experience the digital transformation. They are challenged by new Information and Communications Technologies (ICT) such as Industrial Internet-of-Things and Artificial intelligence 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. For instance, the most known framework dealing with it is the "Reference Architectural Model for 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.

The research problem we want to address in this PhD thesis proposal is related to this weakness. The existing literature still does not respond to this deep need. 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 various fields including various 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]. To do so, requirements are translated into intent policies. In general, the intention-based mediacy would provide means for a context-aware adoption and configuration of underlying digital technologies.

The research goal of this PhD project is to elaborate an intention-based approach to facilitate the integration of new ICT into organizations dynamically during all the Information System lifecycle. This should help organizations to adapt as quickly as possible to the environment changes. The work on this thesis will include:

- Preparation of a State-of-the-Art on intent 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, Information System Architecture, Distributed Systems

Please send your application (CV and cover letter) before the 5th June 2020 to stage.isid-mim@cnam.fr.

Bibliography:

1. Kornysheva, E.; Deneckere, R. and Rolland, C. Method Families Concept: Application to Decision-Making Methods. In *Enterprise, Business-Process and Information Systems Modeling*, pages 413-427, Springer, London, United Kingdom, Lecture Notes in Business Information Processing 81, 2011.
2. Lu Y., Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration* 6 (2017) 1–10.
3. Issa A., Hatiboglu B., Bildstein A., Bauernhansl T., Industrie 4.0 roadmap: Framework for digital transformation based on the concepts of capability maturity and alignment, *Procedia CIRP*, Volume 72, 2018, Pages 973-978.
4. Aldea A., Iacob M-E., Wombacher A., Hiralal M., Franck T. Enterprise Architecture 4.0 – A vision, an approach and software tool support. *IEEE 22nd International Enterprise Distributed Object Computing Conference*. 2018.
5. The Reference Architectural Model RAMI 4.0 and the Industrie 4.0 Component. 2015. <https://www.zvei.org/en/subjects/industrie-4-0/the-reference-architectural-model-rami-40-and-the-industrie-40-component/>, Accessed on January 2020.
6. Adolphs P., Bedenbender H., Dirzus D., Ehlich M., Epple U., Hankel M., Heidel R., Hoffmeister M., Huhle H., Kärcher B., Koziolk H., Pichler R., Pollmeier S., Schewe F., Walter A., Waser B., Wollschlaeger M. Reference Architecture Model Industrie 4.0 (RAMI4.0). 2015.
7. Deneckere, R. and Kornysheva, E. Processus téléologique et variabilité : Utilisation de la sensibilité au contexte. In *Revue des Sciences et Technologies de l'Information - Série ISI : Ingénierie des Systèmes d'Information*, 16:1: 61-88, 2011.
8. Han Y., Li J., Hoang D., Yoo J.-H., Won-Ki Hong J., An intent-based network virtualization platform for SDN, *12th International Conference on Network and Service Management (CNSM)*, 2016, 353-358.