

Accepted Manuscript

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PII: S2452-414X(16)30065-6

DOI: [10.1016/j.jii.2016.09.002](https://doi.org/10.1016/j.jii.2016.09.002)

Reference: JII 20

To appear in: *Journal of Industrial Information Integration*



Please cite this article as: Didem Gürdür , Jad El-Khoury , Tiberiu Seceleanu , Luka Lednicki , Making Interoperability Visible: Data Visualization of Cyber-Physical Systems Development Tool Chains , *Journal of Industrial Information Integration* (2016), doi: [10.1016/j.jii.2016.09.002](https://doi.org/10.1016/j.jii.2016.09.002)

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Making Interoperability Visible: Data Visualization of Cyber-Physical Systems Development Tool Chains

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Abstract. *Cyber-physical system (CPS) development cycles include various engineering disciplines, artefacts, and areas of expertise. There are powerful software tools used in these cycles, which can be put to good use by one individual discipline but are challenging to integrate with other tools. This paper discusses a node-link diagram (NLD) visualization technique that can be used to visualize interoperability in CPS development tool chains. The purpose is to help tool chain developers assess the current interoperability status and make decisions on integration scenarios accordingly. To this end, a case study is introduced and explained as an example. Data about the tool chain, which contains different structures relating to the software tools usage and the interactions between them, are provided by ABB Corporate Research Centre. These structures are used in creation of visualizations for making interoperability visible in CPS development tool chains and applicability of each visualization technique is discussed with the interoperability perspective. In this study, we also exercised a clustering algorithm for an extended case study and discussed the use of visualizations to improve interoperability in CPS development environments.*

Keywords: cyber-physical system interoperability, interoperability visualization, development tool chains, data visualization, node-link diagram.

1. Introduction

Cyber-physical systems (CPS) involve the integration of computation and physical processes (Lee, 2006). Development of CPS requires tool support for the tasks associated with different engineering disciplines throughout the different phases of the product lifecycle (see Figure 1). These tools produce artifacts and product data with both internal and external dependencies. Moreover, “efficient development of these products necessitates support for dealing with the intricated relations between viewpoints, at the levels of people, models and tools” (Törngren et al., 2014, p. 746).

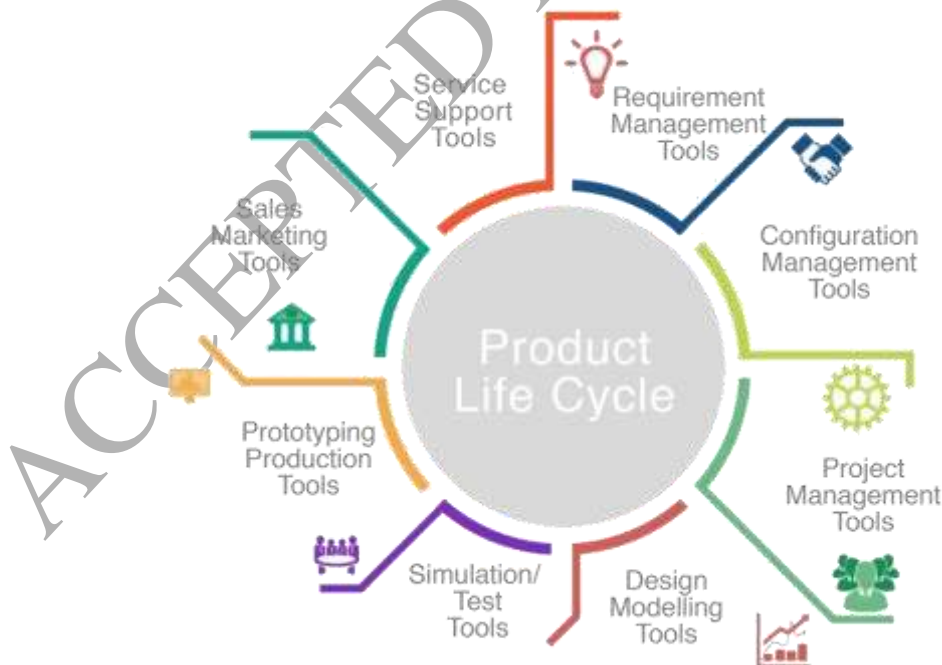


Figure 1. Product life cycle and various software tool categories.

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