ABSTRACT

Engineering 4.0 – A study of the efficiency potential and the use of CAE software in electrical design for engineering machines and plant systems

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E4TC research report exclusively available from EPLAN

New Engineering 4.0 Study

The European 4.0 Transformation Center (E4TC) at the RWTH Aachen Campus studied the strategic digitisation of design and control engineering for machines and plant systems. The 36-page research report, "Engineering 4.0 – A study of the efficiency potential and the use of CAE software in electrical design for engineering machines and plant systems" is based on an eight-month field study of German machine engineering companies that manufacture mass-produced machines and special machines, engineering offices/hardware planners and device manufacturers. The methodology developed, which quantifies potentials and procedures in engineering, makes possible for the first time a well-founded evaluation of current engineering workflows in mass machine manufacturing and special machine manufacturing. The central finding: the partial automation of engineering results in the best ratio between effort and benefit from a business standpoint.

Engineering Workflow Model – Efficiency Level Matrix

The E4TC researchers in Aachen first introduced a reference model for the engineering workflow and created an evaluation matrix with five levels of efficiency. The Efficiency Level Matrix, with detailed statements about Methodology Workflow, is accompanied by a Use Level Matrix. This describes and evaluates the use of CAE software as the basic prerequisite for Engineering 4.0. The study indicates the object of research right at the start: a total of ten process steps that are characteristic for engineering in machine construction (mass produced/special machines). The generated Engineering Workflow Model comprises the typical work steps for processing an order.

The researchers focused on the work fields of engineering, design, bills of materials, reports, control cabinet layout and devices and templates. The reasons for this are clear: "The dependencies on customers or partners in these process steps range from relatively low to non-existent," says E4TC Managing Director Dr Thomas Gartzen. "Companies literally have complete control in these areas to tap into potential time and cost savings through standardisation or automation projects." The path to higher efficiencies in the value chain is mapped out using traditional methods, from standardisation up to automation. To be able to evaluate the efficiency of each work step, the study

scaled the workflow methodology into five stages – each corresponding to an efficiency level (eLevel) of engineering.

Findings

Using the collected data, the researchers determined that companies can become around 20 percent more efficient in their overall processes as they move from eLevel to eLevel. Device-oriented work methods bring 25 percent time savings in the creation of schematics. Using a circuit library for product functions resulted in 50 percent time savings. Another 25 percent reduction can be achieved by introducing partial automation. And standardisation completely eliminates the time necessary for creating reports.

Engineering Workflow Model “Design & Construction” (Work Steps 1–8)

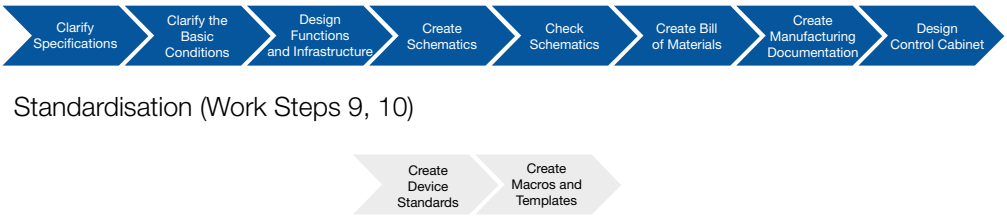

Figure 1: Engineering Workflow Model

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eLevel		Work Method Characteristics per Work Step
1	“traditional”	Graphically oriented work method, symbols, manually created schematics, typical design of new circuits (ETO share)
2	“partially standardised”	Graphically oriented work method, use of product macros, creation of device databases, device selection
3	“standardised”	Graphical and device-oriented work methods, use of a circuit library for production functions, central macro projects, modularisation, consistent reuse, fully automatic report creation, introduction of division of labour in engineering into order processing and data creation for standardisation
4	“partially automated”	Use of a comprehensive circuit library and of design methods including options, variants, importing data, offline ERP/PDM integration
5	“automated”	Use of generation and configuration functions, integration into the entire process (ERP/PDM), sales configurations (a degree of automation up to 100 percent)

Figure 2: “Methodology Workflow” Efficiency Level (eLevel) Definition

eLevel	Work Steps 4–7: Savings in direct work in the system (schematics creation)	Work Steps 9, 10: Efforts for standardisation, pro rata basis per order	Resulting Total Potential, Work Steps 1–10
1. “traditional”	–	–	–
2. “partially standardised”	25 %	5 %	20 %
3. “standardised”	50 %	10 %	40 %
4. “partially automated”	75 %	15 %	60 %
5. “automated”	100 %	20 %	80 %

Figure 3: Efficiency Table

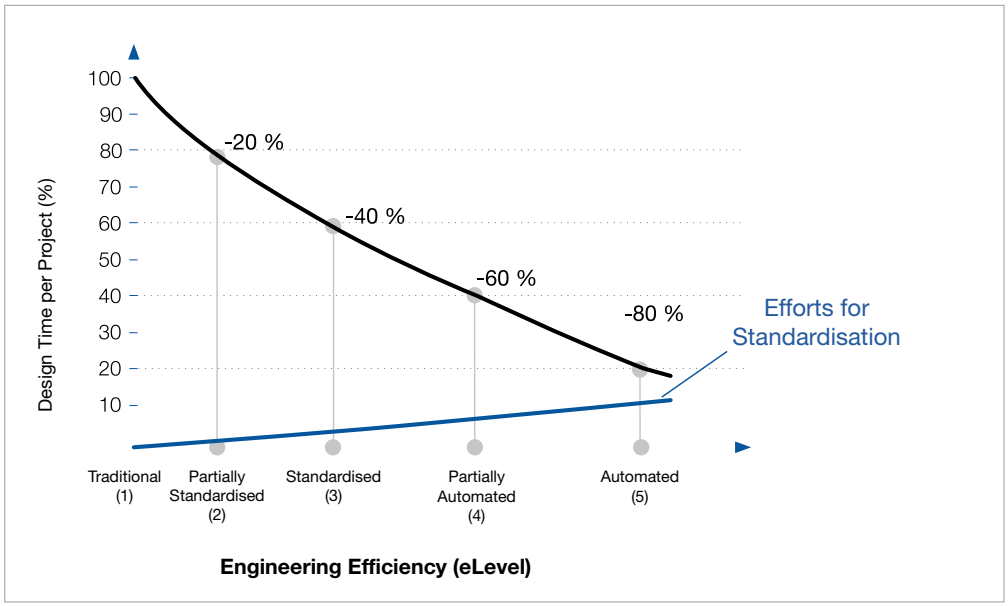

Figure 4: Engineering Efficiency Curve

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