VIRTUAL SIMULATION AND VALIDATION OF A ROBOTIC WORK CELL USING DELMIA SOFTWARE

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Abstract: The paper presents the virtual simulation possibilities of a manufacturing process what contains two operation: Turning and Milling operations of the Z11 gear part, this project was made in „Star Transmission Cugir" factory. The main goal was to streamline the production process and to reduce the working time with at least 50%, this is the main purpose of all the departments involved in a project (invest, purchasing and production departments). Technology advances at a very broad led to the possibility of real-time simulation of many applications in industry. That is the reason for reducing costs by the deployment of automated technological process, be it simple or complex, since verification by simulation does not imply a massive consumption of materials for various initial testing.

1. INTRODUCTION

As a solution of Dassault Systemes PLM software [1], Delmia is the solution for Digital Manufacturing and digital simulation for all the steps of a production planning and execution.

DELMIA allows, in digital processing for producers from any industry, to define, planning, create, monitoring and control of all production processes. Also provides a whole range of applications dedicated to industries, combining the ability to capture and implement best practices for the processing industry and environment, for knowledge and management of resources and processes.

This technology allows the production engineers and technicians to study from the first steps of the design and development of a product to interact with the technological aspects of the manufacturing, simulation of a production plan, the layout of the production facility and to avoid a lot of real problems that could appear during the real implementation of the technologies. All these facilities allow the company to get a better competitive advance, to improve efficiency and inovative technologies and to shorten the time to market rate for the new products with a minimum cost. Also, the solution is very important for the investments and business planning because they can be simulated and optimized before the real start of the process.

The main advantage of the DELMIA PLM solution is to keep a very reliable and accurate link between the design data and the manufacturing and after sale data. The most important industries that used this digital solution are: Automotive, Aero-spatiale, Naval and general manufacturing industries, [5].

2. THE LAYOUT OF THE WORK CELL

The layout of the robotic work cell is shown in figure 1.The main components of the work cell are listed bellow:

A – Rotary feeder of parts
B – KUKA 1 Robot (KRL125L100-2 for handling in turning operation)
C – Conveyor

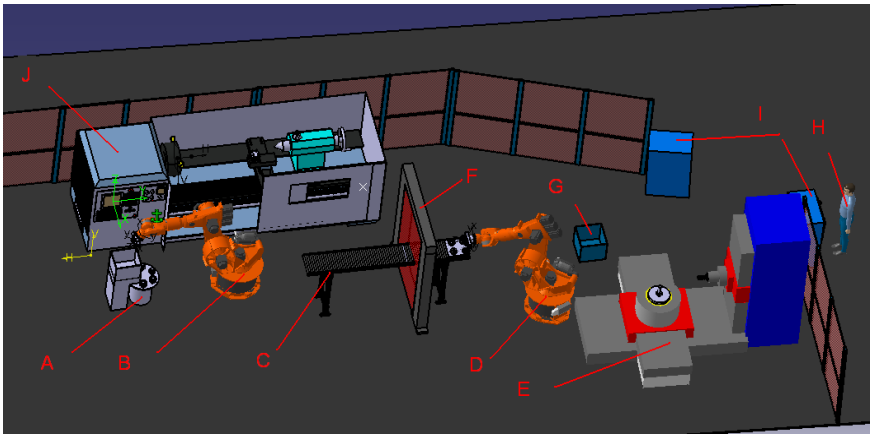

Figure 1 The robotic work cell

D – KUKA 2 Robot (KRL125L100 – 2, for handling in milling operation)
E – CNC gear milling machine - Gleason GENESIS ® 210 H
F – Sensors curtain
G – Finished Parts storage
H – Work Cell operator
I – PLCs of work cell
J – CNC turning machine - GILDEMEISTER CTX 500

3. VIRTUAL MANUFACTURING STAGES

3.1 PHASE I:

The KUKA 1 robot (B) supplies with workpieces, from the feeder (A), the CNC turning machine (J) for operation: Turning1

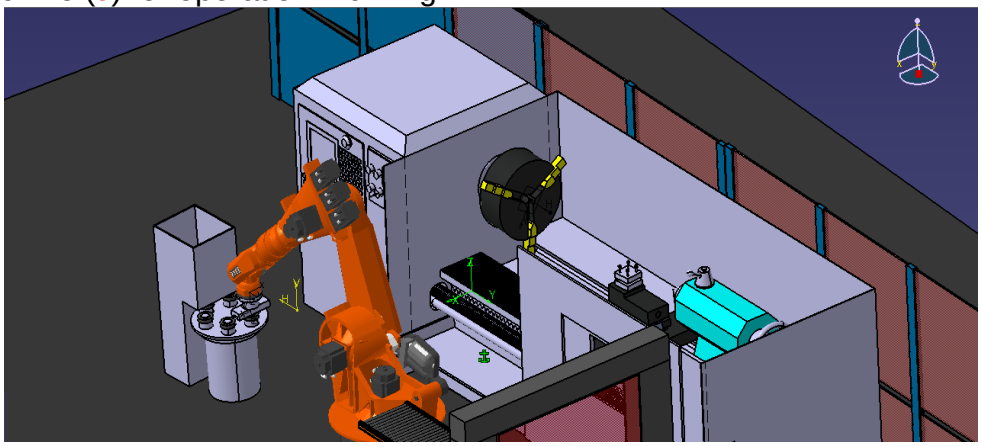

Figura 2. Phase 1, operation1

When the robot reaches the jaws of universal with workpiece, they come close and fix the workpiece. When they are completely closed (jaw counter sensor enabled) therobot moves in the feeder (A), lathe door (J) closes and the machine starts turning the outer front diameter and front turning. When the program ended CNC turning, the lathe door (J) opens and the robot 1 (B) grabs the part, lathe jaws (J) are opened and the robot 1 (B) go back on the table of part feeder (A) to be flipped 180^0.
Having the flipped part, the robot 1 (B) provides, again, the part in the lathe jaws (J) to achieve the turning operation 2: external turning, and turning the inner front .When CNC turning program ended, the door lathe (J) is open and the robot place the part on the

conveyor table, the feeder table (A) rotates 60 ° and the cycle repeats until first robot 1 (B) provides four pieces flipped on the conveyor table (A).

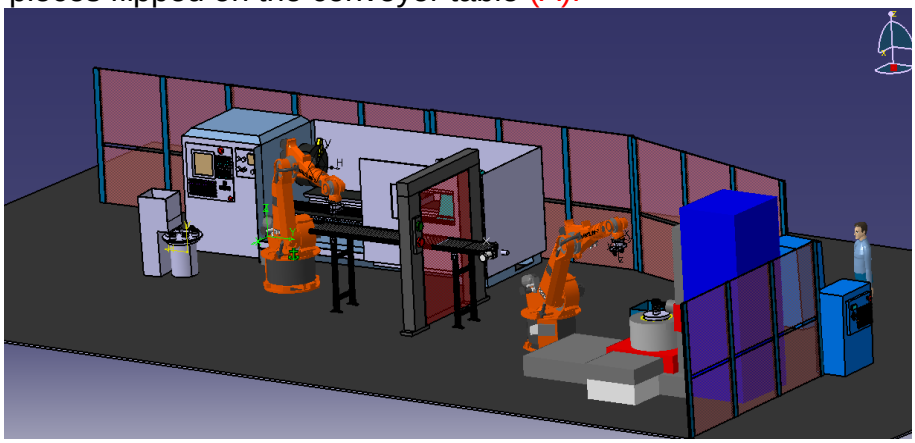

Figure 3. Phase 1, operation 2 and transport

3.2. PHASE II:

Conveyor table (C) is shifted axially to robot 2 (D), while passing through the "veil" of sensors (F).The role of the curtains of sensors is to measure both outer and inner diameter of the workpiece and to control and modify the lathe corrections (J), the so-called Automatic Control System Offset -'s.

This control system allows corrections through a software curtains communication between sensors and numerical control lathe (J).

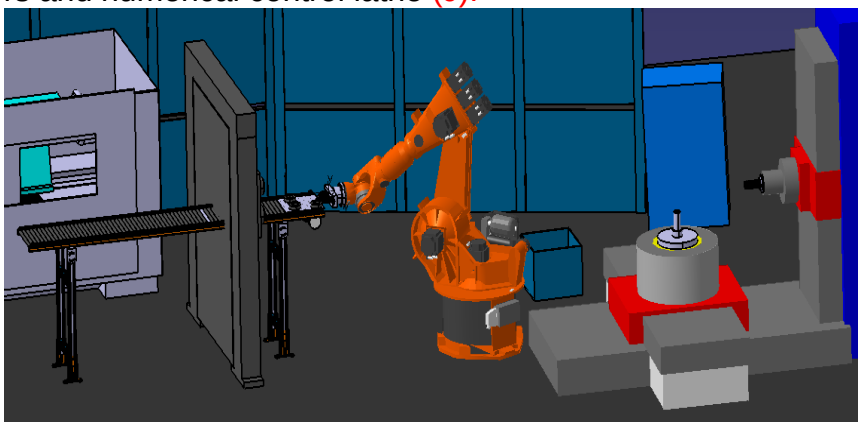

Figure 4. Phase II, operation 1

This communication takes the form of a continuous transfer of tabular files that actually contain offsets that are take into account by the lathe (J).If the piece is not within the tolerances permitted when robot 2 (D) will be lead out of her way to the gear milling machine (E).If the piece is within tolerances it will get through Robot 2 (D), to the gear milling machine (E).This phase ends when the pneumatic punch on the table milling machine teeth, get five pieces.

3.3 PHASE III:

After the robot 2 (D) finished to put the five pieces on gear milling machine, it will retire in neutral point and gear milling machine (E) will start working. When the gear milling machine (E) finished the robot 2 (D) will take two pieces together, and place it in the transport stack (G) and then retreates in nearby of conveyor (C). Control and monitoring

role goes to a single human operator for the work cell (H).It will turn on, control, monitor, and will stop in an emergencythe work cell. Also he make sure both semi-flow in the rotary feeder parts (A) and in the finished parts storage box (G).

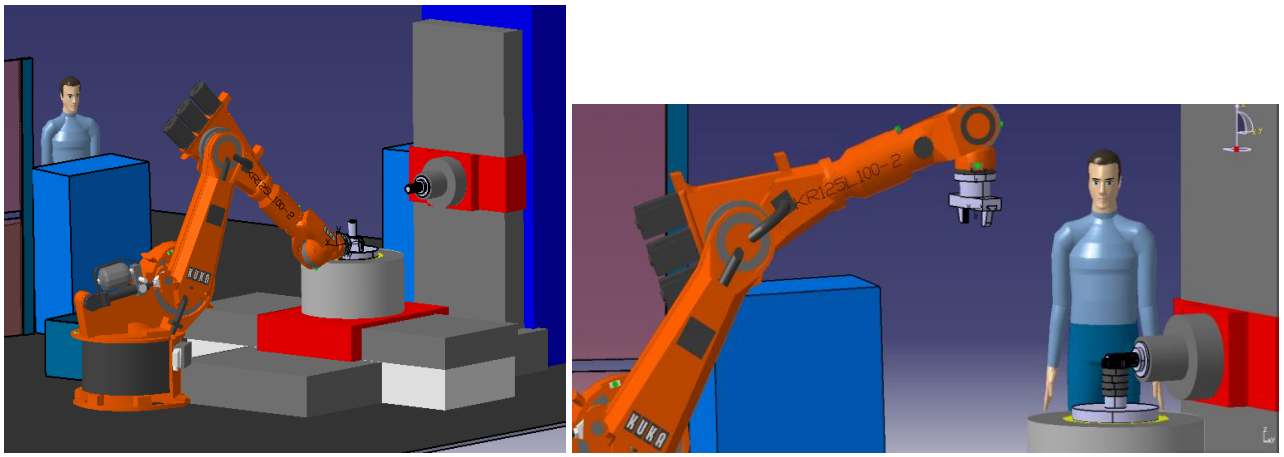

Figure 5. Phase III, final operation

An important feature of the elements forming work cell, is the hierarchy. Forever always the lead role, will be hold by a master robot, in this case the master role is provided by PLC – cell for the robot 1 (B).

4. CONCLUSIONS

The automatic virtual validation of Delmia offers to the control engineers the possibility to implement the PLC codes for repair with a lot of time before they are phisicaly implemented in the real equipment.

The virtual equipment used allow the engineers to simulate any kind of deffect and to explore different scenarios type „what if?" which are difficult to predict even in real conditions. The fact that design errors can be removed from the PLC, control engineers can, also, to reduce the risk of physical damage to equipment controlled by PLC. Validation control to virtual commissioning physical on-site, allows users to significantly reduce construction time and cost of manufacturing systems for maintenance operations.

The researches achieved by the present paper alowed the designers of the technological process from „Star transmission" Cugir factory to simulate the production process of the toothed whell used in the real plant production facility and gave the opportunity to the technical staff to follow and optimize the process in virtual manufacturing environment.

References:

1. ARC Advisory Group. DELMIA V5 Automation Platform: Merging Digital Manufacturing with Automation. In 2006.
2. Davidson & Tobias Joakim Sennö. Interactive Control of the Virtual Machine. Lund, Sweden, Department of Industrial Electrical Engineering and Automation Lund University, 2005.
3. Samir Delilah, Marcus Persson. Development of year Event Simulation Implemented Bases in Process Simulate Robotics. Gothenburg, Sweden: Chalmers University of Technology, 2009.
4. Systèmes, Dassault. DELMIA Version 5 Release 19 User's Documentation.2008.
5. Systèmes, Dassault. About Dassault Systèmes - Dassault Systèmes. PLM Solutions, 3D CAD & simulation software - Dassault Systèmes. [Online], http://www.3ds.com/company/about-dassault-systemes/our-vision/.