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TOWARDS AUTOMATED SIMULATION INPUT DATA: AN OPEN SOURCE TOOL TO ENHANCE THE INPUT DATA PHASE IN DISCRETE EVENT SIMULATION

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ABSTRACT

Discrete Event Simulation (DES) is one of the most effective tools for planning, designing and improving material flows in production. One of the main weaknesses of operating DES is the exertion needed and costs spent on collecting and handling the input data from different organization's data resources. To tackle the problem of the time consuming input data process for DES projects a tool, called Knowledge Extraction (KE) tool is developed. The open-source (OS) tool reads data from several resources of an organisation; analyses it using statistical analysis and outputs it in a format that is applicable to be used by a simulation tool. The tool can export the already processed data in formats readable to simulation software in order to cover the increasing need to integrate simulation with other manufacturing applications; the primary one follows the Core Manufacturing Simulation Data (CMSD).

1 INTRODUCTION

DES has proved itself to be an effective tool for complex process analysis and it is argued that the input data procedure is the most critical and time-consuming phase in DES projects (Banks 1998). The time spent on the input data procedure is typically as much as 10-40% of the total time of a DES project (Skoogh and Johansson 2007). Major issues that lead to extreme time consumption, relate to low quality data and massive manual workload to transform raw data into simulation input (Onggo, Hill, and Brooks 2013). Although the cost of applying and using simulation technology is high with the cost of integrating simulation systems with other manufacturing applications even higher (Leong, Lee, and Riddick 2006); this provides the motivation for this research, that is the development of an OS tool for the transfer and input data of from an Enterprise Resource Planning (ERP) systems, Manufacturing Execution Systems (MES) or other data sources of the company to the simulation model. By developing the tool in Python, a popular all-purpose scripting language used by scientists and engineers doing scientific computing, the research objective is to enhance the input data phase in DES. In the following section we present a new OS tool that is implemented in Python, targeting mainly the enhancement of the input data phase but also useful for other phases as a complete simulation data management tool (output analysis, see below).

2 KNOWLEDGE EXTRACTION TOOL

The tool is intended to connect raw data recorded in different IT-systems at organizations with the simulation software. After a review of OS data science tools we used RPy2 (http://rpy.sourceforge.net/rpy2.html), which is an interface between Python and R (scripting language mostly popular for data analysis and statistics). This interface gives us the ability to have full access to R functions from a Python script. It can be used under the GNU Lesser General Public License (LGPL), which makes it feasible to be also used in proprietary projects.

Using the capabilities of the Python programming language we are able to extract and import data to the tool from different data sources. The import and extraction of data to the tool is the main role of the first component "Data extraction" (see Figure 1). The transformation of the data samples into useful simulation information is mainly conducted by the second component of the tool called "Data processing" (see Figure 1). The outcome of the "Data processing" component of the tool should be provided in a readable format to a Simulation Engine (SE), this is exactly the role of the third component called "Output preparation" (see Figure 1). The CMSD standard is suggested as the primary output of this tool, so Extensible Markup Language (XML) files that follow the CMSD standard can be used as input for the SE (Barlas, Dagkakis, and Heavey 2013). The last component of the tool comes after the run of the simulation model called "Output analysis" (see Figure 1). Output simulation analysis is the last modeling stage in a simulation study; it is concerned with the statistical analysis of the output data.

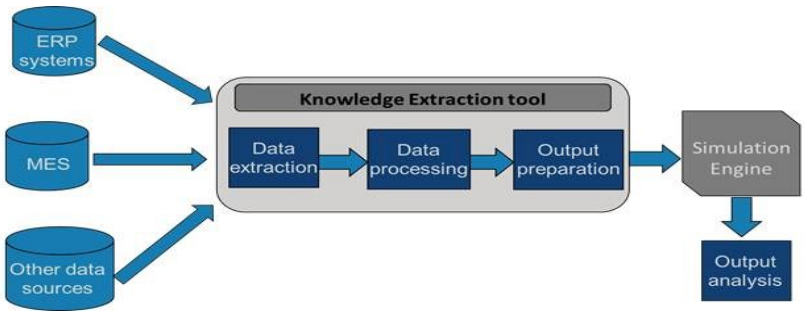

Figure 1: Knowledge Extraction tool's architecture

The main requirements that we followed in our development process is that the KE tool should be modular, extensible, OS, fast and flexible. Taking into consideration the above we developed objects that cover the core components of the tool. Every object has its own attributes encapsulated in its code and outputs its results when is called to be executed. The KE tool is being currently validated through four industrial pilot cases. More information about the different developed objects is available in GitHub at the following URL (https://github.com/nexedi/dream/tree/master/dream/KnowledgeExtraction). In the repository one can find and download the developed objects themselves, examples with the development of KE tool main script in different simulation topologies and a thorough documentation of the tool. The code kept under version control with Git (http://git-scm.com/), the user can clone and manipulate the different versions of the code through the project repository in GitHub.

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