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Development of a classification and generation approach for innovative technologies

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Abstract

This paper considers the state of the art and analyses five existing classification principles for technological and manufacturing processes aiming at the part and product formation. The proposed energetic-information model describes the generation of technological schemes and processes, based on the system description for structural conversion, transfer and interaction of material, energy and information. Classification principles for technological processes and their structural description generate classes, types and procedures (methods). A generation procedure and mechanism for innovative technological processes is developed. Approved classification of manufacturing processes for DIN8580, NISTIR 7913, according to Todd, Paul De Garmo, by Ashby are particular cases of the proposed classification approach. The proposed approach and process classification system is forming an image of DIN8580. The classification, generation and analysis approach for manufacturing technologies applies for the creation of innovative procedures, manufacturing equipment and systems.

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Keywords: methods, manufacturing processes, technology, classification

"First of all learn the exact name for everything - that's the primary and most important science of all sciences." [Pythagoras von Samos]

1. Introduction

The term "progress" relates to a system consisting of elements, links, connections and interactions both between elements and with the environment in order to identify their properties and characteristics. Processes are caused by

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changes in properties and states and result from elements and external interactions. These characterize the system performance, setting changes in state and in space - time related properties. Most important cognition tools for the state, evolution and trend are minds, terms and their content, the system structure and equivalent model, which describe those properties and characteristics. Currently we apply a variety of manufacturing techniques for the part and product formation and different technological processes and manufacturing equipment for their implementation. The state of the art in classification principles for technological processes and manufacturing techniques [1,2,3,4,5,9] is systematically structured and presented in table 1.

Table 1. Classification principles for technological processes and manufacturing techniques

Classification by	Classification principles	Classification criteria	Advantages
National Institute of Standards and Technology NISTIR 7913 (USA) [1]	5 physical process clusters: 1 – change in mass 2 – material state changes 3 – structural changes 4 – shape changes 5 – joining	Physical state change	Use of research information
R.H. Todd et al. (USA) [2]	6 shape change clusters: 1 – mass reduction 2 – thermal mass reduction 3 – chemical mass reduction 4 – keeping mass 5 – linking 6 – joining 4 manufacturing process clusters: 1 – hardening 2 – tempering 3 – surface preparation 4 – surface coating	Shape change, without shape change	Easy of use
Standard DIN 8580:2003-09 (Germany) [3]	6 manufacturing process clusters: 1 – Primary shaping, 2 – Forming, 3 – Separating, 4 – Joining, 5 – Coating, 6 – Modification of material properties	Shape change, Material property change	Used by CIRP group CO2PE! for defining the specifications of machining processes
E. Paul De Garmo (USA) [4]	7 manufacturing process clusters: 1 – casting or forming 2 – shape change or cutting 3 – machining, ablation 4 – thermal processes 5 – finishing 6 – assembling 7 – check	Casting, Shape and material property changes	Easy to understand
M.F.Ashby (GB) [5]	4 manufacturing process clusters: 1 – primary shaping 2 – secondary shaping 3 – joining 4 – finishing	Primary and secondary processes	Easy to understand