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Manufacturing Execution Systems

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ABSTRACT

Title: **Manufacturing Execution Systems**
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The term Manufacturing Execution Systems (MES) was created in 1990 by Advanced Manufacturing Research (AMR) to describe the suite of software products which enables the execution of manufacturing through the integration of planning and control systems.

The purpose of this dissertation is to determine the current status of MES and to investigate the possible role of the Industrial Engineer in the development, implementation and use of MES. To achieve this objective, the most commonly accepted, recent and relevant definitions, business models, functions and developments of MES are investigated. Based on these, a new MES Function Matrix is developed and validated by a case study. Finally, Industrial Engineering is related to MES and the role of the Industrial Engineer promoted.

The emergence of MES is a result of the evolution of three interrelated elements, namely manufacturing strategies, manufacturing planning and control systems and information technology. The development of global markets and the requirement for agile manufacturing led to the need for MES.

The evolution of various aspects of Enterprise Resource Planning (ERP), and more specifically Manufacturing Planning and Control (MPC) systems, is discussed as part of the investigation of the development of MES. The Three-Layer-model and REPAC-model by AMR Research, as well as variations of these models compiled by MESA ("International MES Association"), are investigated. Manufacturing execution is absent in traditional MPC models. Modern models, such as the Three-Layer-model, suggest an execution layer to be inserted between the planning and control layers.

The investigation of the function models of McClellan and MESA International indicates that discrepancies exist between these models with regard to the functions of MES. A new MES Function Matrix is developed to address such shortcomings and is applied to a case study of DIAMES, a software product used by Aberdare Cables and promoted as an MES product.

As an MES developer, the Industrial Engineer can act as designer, planner and innovator. The greatest value can, however, be added by the Industrial Engineer as integrator to ensure that horizontal plant-wide execution takes place, and not only vertical "islands of automation" integrated with planning systems. In order to accomplish this, the Industrial Engineer needs to fulfill the roles of boundary-spanner, facilitator, coordinator, analyst, chairperson, decision-maker, as well as trainer or educator. MES can also be used by the Industrial Engineer as a tool, for example as part of a program of continuous improvement.

The identification of the relationship between the expertise of the Industrial Engineer and the roles to be played within the MES arena gave birth to the establishment of an MES research initiative at the Department of Industrial and Systems Engineering of the University of Pretoria.

Key Words:

- Manufacturing Execution Systems (MES)
- Industrial Engineering (IE)
- Enterprise Resource Planning (ERP)
- Control Systems
- Manufacturing Planning and Control Systems (MPC)
- Information Technology (IT)
- Manufacturing Systems
- Supply Chain Management (SCM)
- Business System Integration
- Agile Manufacturing

OPSOMMING

Titel: **Vervaardigingsuitvoeringstelsels**
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Departement: **Bedryfs- en Sisteemingenieurswese**
Graad: **Magister Ingenieurswese**

Die term Vervaardigingsuitvoeringstelsels ("Manufacturing Execution Systems" – MES) is in 1990 deur Advanced Manufacturing Systems (AMR) geskep om die sagtewareprodukte te beskryf wat die uitvoering van vervaardigingsplanne, deur die integrasie van beplanning- en beheerstelsels, moontlik maak.

Die doel van hierdie verhandeling is om die huidige status van MES te bepaal en die moontlike rol van die Bedryfsingenieur in die ontwikkeling, implementering en gebruik van MES te ondersoek. Om hierdie doel te bereik word die algemeen aanvaarde, resente en relevante definisies, besigheidsmodelle, funksies en ontwikkelings van MES ondersoek. Gebaseer hierop is 'n nuwe MES Funksionele Matriks ontwikkeling en getoets met 'n gevallestudie. Laastens word die verhouding tussen MES en Bedryfsingenieurswese bepaal en die rol van die Bedryfsingenieur uitgebou.

MES is 'n resultaat van die evolusie van drie verwante aspekte, naamlik vervaardigingstrategieë, vervaardigingsbeplanning en -beheerstelsels en inligtingstegnologie. Die opkoms van globale markte en die vereiste vir buigbare, ratse vervaardiging ("agile manufacturing") het aanleiding gegee tot die behoefte vir MES.

Die evolusie van verskeie aspekte van besigheidshulpbronbeplanning (ERP), en meer spesifiek vervaardigingsbeplanning- en beheerstelsels (MPC), word bespreek as deel van die ondersoek na die ontwikkeling van MES. Die Drie-Vlak-model en die REPAC-modelle van AMR Research, asook variasies daarvan soos opgestel deur MESA ("International MES Association"), is ondersoek. Vervaardigingsuitvoering is afwesig in die tradisionele modelle van vervaardigingsbeplanning en -beheer. Moderne modelle,

soos die Drie-Vlak-model, stel voor dat 'n uitvoeringsvlak tussen die beplanning- en beheervlakke ingevoeg word.

Die ondersoek van die funksionele modelle van McClellan en MESA dui aan dat verskille bestaan ten opsigte van die funksies van MES. 'n Nuwe MES Funksionele Matriks is ontwikkel om hierdie tekortkominge aan te spreek en word getoets in 'n gevallestudie van DIAMES, 'n sagteware-produk wat by Aberdare Cables gebruik en as 'n vervaardigingsuitvoeringstelsel (MES) bemark word.

As 'n MES-ontwikkelaar kan die Bedryfsingenieur optree as 'n ontwerper, beplanner en innoveerder. Die grootste waarde kan egter deur die Bedryfsingenieur bygevoeg as integreerder, deur te verseker dat horisontale, aanlegwye uitvoering plaasvind en nie alleen vertikale "eilande van outomatisering" nie. Om dit te bereik, moet die Bedryfsingenieur die rolle vervul van brugbouer, fasiliteerder, koördineerder, analis, voorsitter, besluitnemer en opleier. MES kan ook deur die Bedryfsingenieur gebruik word as gereedskapstuk, byvoorbeeld as deel van 'n program vir kontinue verbetering. Die identifisering van die verwantskap tussen die kennisvelde van die Bedryfsingenieur en die rolle in die MES-arena het aanleiding gegee tot die vestiging van 'n MES-navorsingsinisiatief by die Departement van Bedryfs- en Sisteemingenieurswese van die Universiteit van Pretoria.

Sleutelwoorde:

- Vervaardigingsuitvoeringstelsels
- Bedryfsingenieurswese
- Besigheidshulpbronbeplanning
- Beheerstelsels
- Vervaardigingsbestuurstelsels
- Informasietegnologie
- Vervaardigingstelsels
- Voorsieningskanaalbestuur
- Besigheidstelselintegrasie
- Aanpasbare vervaardiging

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