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The Development of a Hybrid Knowledge-Based System for Designing a Low Volume Automotive Manufacturing Environment. The Development of A Hybrid Knowledge-Based (KB)/Gauging Absences of Pre-Requisites (GAP)/Analytic Hierarchy Process (AHP) System for the Design and Implementation of a Low Volume Automotive Manufacturing (LVAM) Environment.

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ABSTRACT

Keywords: Low Volume Automotive Manufacturing (LVAM), Lean Manufacturing, Knowledge Based (KB), Gauging Absences of Pre-requisites (GAP), Analytic Hierarchy Process (AHP)

The product development process for the automotive industry is normally complicated, lengthy, expensive, and risky. Hence, a study on a new concept for Low Volume Automotive Manufacturing (LVAM), used for niche car models manufacturing, is proposed to overcome this issue. The development of a hybrid Knowledge Based (KB) System, which is a blend of KB System, Gauging Absences of Pre-requisites (GAP), and Analytic Hierarchy Process (AHP) is proposed for LVAM research. The hybrid KB/GAP/AHP System identifies all potential elements of LVAM issues throughout the development of this system. The KB System used in the LVAM analyses the gap between the existing and the benchmark organisations for an effective implementation.

The novelty and differences in the current research approach emphasises the use of Knowledge Based (KB) System in the planning and designing stages by suggesting recommendations of LVAM implementation, through: a) developing the conceptual LVAM model; b) designing the KBLVAM System structure based on the conceptual LVAM model; and c) embedding Gauging Absences of Pre-requisites (GAP) analysis and Analytic Hierarchy Process (AHP) approach in the hybrid KBLVAM System.

The KBLVAM Model explores five major perspectives in two stages. Planning Stage (Stage 1) consists of *Manufacturer Environment* Perspective (Level 0), *LVAM Manufacturer Business* Perspective (Level 1), and *LVAM Manufacturer Resource* Perspective (Level 2). Design Stage (Stage 2) consists of *LVAM Manufacturer Capability – Car Body Part Manufacturing* Perspective (Level 3), *LVAM Manufacturer Capability – Competitive Priorities* Perspective (Level 4), and *LVAM Manufacturer Capability – Lean Process Optimisation* Perspective (Level 5). Each of these perspectives consists of modules and sub-modules that represent specific subjects in the LVAM development. Based on the conceptual LVAM model, all perspectives were transformed into the KBLVAM System structure, which is embedded with the GAP and AHP techniques, hence, key areas of potential improvement are recommended for each activity for LVAM implementation.

In order to be able to address the real situation of LVAM environment, the research verification was conducted for two automotive manufacturers in Malaysia. Some published case studies were also used to check several modules for their validity and reliability. This research concludes that the developed KBLVAM System provides valuable decision making information and knowledge to assist LVAM practitioners to plan, design and implement LVAM in terms of business organisation, manufacturing aspects and practices.

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GLOSSARY

AHP	Analytic Hierarchy Process
AI	Artificial Intelligence
AM	Application Manager
ANN	Artificial Neural Network
APQP	Advance Product Quality Planning
BIW	Body-In-White
BOM	Bill of Materials
BP	Bad Point
CAD	Computer Aided Design
CBR	Case Based Reasoning
CIM	Computer Integrated Manufacturing
CM	Cellular Manufacturing
CNC	Computer Numerical Control
CR	Consistency Ratio
DFM	Design for Manufacturing
DPD	Distributive Product Development
ERP	Enterprise Resource Planning
ES	Expert System
FBS	Frame Based System
FEM	Front End Module
FL	Fuzzy Logic
FMC	Full Model Casting
FMEA	Failure Mode and Effects Analysis
FMS	Flexible Manufacturing System
GA	Genetic Algorithms
GAP	Gauging Absences of Pre-requisites
GM	General Motors
GP	Good Point
HOQ	House of Quality
HRD	Human Resource Development
HVAM	High Volume Automotive Manufacturing
ICT	Information Communication Technology
IT	Inventory Turnover
JIT	Just in Time
KB	Knowledge Based
KBLVAM	Knowledge Based Low Volume Automotive Manufacturing
KBS	Knowledge Based System
KPI	Key Performance Indicator
LVAM	Low Volume Automotive Manufacturing
MHS	Material Handling Systems
MIYAZU	Miyazu Malaysia Sdn. Bhd
NVH	Noise, Vibration and Harshness
NDA	Non-Disclosure Agreement
OEM	Original Equipment Manufacturer
OICA	International Organization of Motor Vehicle Manufacturers
OOP	Object Oriented Programming
PC	Problem Category
PFMEA	Process Failure Mode and Effects Analysis
PME	Primary Manufacturing Enterprise
PMH	Polymer Metal Hybrid

PMS	Performance Management System
PROTON	Perusahaan Otomobil Nasional Sdn. Bhd
QCC	Quality Control Circle
QFD	Quality Function Deployment
RAM	Random Access Memory
ROE	Return on Equity
RTA	Return on Total Assets
SA	Simulated Annealing
SMC	System Manufacturing Company
SMC	Sheet Moulding Compound
SME	Small and Medium Enterprises
SMED	Single Minute Exchange of Dies
SPC	Statistical Process Control
SPIF	Single Point Incremental Forming
STA	Sales to Total Assets
TOYOTA	Toyota Motor Corporation
TPM	Total Productive Maintenance
TPS	Toyota Production System
TQM	Total Quality Management
TWB	Tailor Welded Blanks
VW	Volkswagen
WCM	World Class Manufacturing
WIP	Work-In-Process
YTD	Year to Date