Sustainable Production and Logistics in Global Networks

43\textsuperscript{rd} CIRP International Conference on Manufacturing Systems
26 – 28 May 2010, Vienna

Proceedings
PROCEEDINGS

International Conference on Manufacturing Systems

26 – 28 May 2010

Organised by

Vienna University of Technology
Institute of Management Science
Division Production Engineering and System Planning

Fraunhofer Austria Research GmbH
Division Production and Logistics Management
www.fraunhofer.at / office@fraunhofer.at

Editors:

Wilfried Sihn  Peter Kuhlang

Vienna · Graz 2010
# Table of Contents

Foreword ............................................................................................................................. III
Committees .......................................................................................................................... IV
Acknowledgements ............................................................................................................. V
A short view on CIRP .......................................................................................................... VI

**Key-notes** ....................................................................................................................... 1

Should CIRP develop a Production Theory? Motivation • Development Path • Framework .................................................................................................................. 3
  H.-P. Wiendahl, P. Nyhuis, W. Hartmann

Manufacturing Systems Sustainability Through Perfect Co-evolution ........................................... 19
  H.A. ElMaraghy

**Production & logistic networks** .................................................................................... 29

A Production Planning and Scheduling Architecture for Networked-manufacturing System based on Available-to-Promise ................................................................................ 31
  Wen Hao Wang, Jie Zhang

Adaptive evaluation method for relocation activities in global production networks ......................................................... 38
  S. Lohmann, P. Ponton, M. Jache, R. Riedel, E. Müller

An Approach for Systematic Production Network Configuration .............................................................................. 45
  A. Kampker, G. Schuh, B. Schüttr, D. Kupke

Analysis of Lead-Time Regulation in an Autonomous Work System ........................................................................... 53
  N. Duffe, H. Rekersbrink, L. Shi, D. Haldor, J. Blazel

Collaboration in Value Creation Networks to improve Material Cycles ........................................................................ 61
  S. Heyer, M. Grismajer, G. Seliger

Development of organizational models for cross-company transport bundling ................................................................................ 69
  Margarethe Prochazka, René Leitner, Felix Meizer, Wilfried Sihn

Impact of influence factors on logistics planning in the Automotive Industry ........................................................................... 77
  D. Palm, W. Sihn
Table of Contents

Improving the distribution of value-added activities in complex business networks considering qualitative factors ........................................... 85
  A. Prinz, S. Ost, J. Mandel

An Integrated Approach to Sustainable Multimodal Transportation in Logistics Networks ........................................................................ 93
  G. Confessore, G. Galiano, G. Liotta, G. Stecca

Concept of transport-oriented scheduling for reduction of inbound logistics traffic .............................................................................. 101
  M. Florian, J. Kemper, W. Sihn, B. Hellingrath

Internet Based Collaboration in the Manufacturing Supply Chain .......... 110
  D. Mourtzis

Nearshoring, Sustainability and Free Trade Facilitation for Global Logistics Networks ........................................................................ 121
  Eleftherios Iakovou, Dimitrios Vlachos, Maria Chatzipanagioti and Ioannis Malikdis

Networked Manufacturing Control: an Industrial Case .......................... 129
  P. Valckenaers, H. Van Brussel, B. Saint Germain, J. Van Belle

Use of the real options analysis to valuate new supplier development – a South Korean case study ...................................................... 137
  G. Lanza, S. Weiler, J. Möhlmann

Self-Configuring Service Network for Decision Support in Sustainable Smart Logistics ................................................................. 145
  A. Smirnov, N. Shilov

Sustainability .......................................................................................... 153

A modular LCA framework for the eco-effective design of production systems ...................................................................................... 155
  C. Brondi, E. Carpanzano

Environmental Assessment of Automotive Joining Processes ............... 163
  J. Pandremoncos, J. Paralikas, A. Fysikopoulos, K. Salonitis and G. Chryssolouris

Fostering sustainability using Sustainable Supply Chain Networks (SSCN) ......................................................................................... 171
  H. Winkler

Green supply chain management in Korean major industries ............... 179
  S. Sim, J. Oh, B. Kim, J. Choi, B. Jeong

VIII
Impact of Manufacturing Supply Chains on the Embodied Energy of Products

S. Kara, S. Mannek

Integrating sustainability into supply chain management – a stakeholder perspective

N. Vojdani, M. Knop

Life Cycle Approaches on Product Realization: meeting the challenges of future production research

M. Wiktorason, G. Sivard, T. Kjellberg

Main drivers of ecological innovation performance

M. Zwainz

A Framework for Modelling Energy Consumption within Manufacturing Systems

Y. Seow, S. Rahimifard

A new Approach for Controlling Disassembly Systems

G. Zülich, J. Hrdina

Polymer Water as Optimal Cutting Fluid - Technological Analysis

C. Hermann, A. Zein

Industrial Smart Metering – Application of information Technology Systems to Improve Energy Efficiency in Manufacturing

C. Hermann, G. Bogdanski, A. Zein

Tactical planning of sustainable transportation by logistics service providers for the automotive industry

M. Preuss, B. Hellingrath

Product and service development/management - special session: IPS²

Analysis of Optimization Algorithms' Usability for the Operational Resource Planning of Industrial Product-Service Systems (IPS²)

H. Meier, B. Funke

Approach for intelligent design and manufacturing of footwear for diabetic persons

M. Germani, M. Mengoni, E. Montiel, R. Raffaeli

Design Method for Life Cycle Oriented Product-Service Systems Development

K. Kimita, F. Akasaka, S. Hosono, Y. Shimomura
Table of Contents

Industrial experience with Life Cycle Costing and the potential of Product-Service Systems ......................................................... 289
  J. Van Ostaeuyen, J. Duffou

Intelligent Process Data Management for product-service-systems in the European Tooling Industry ............................................. 299
  Günther Schuh, Wolfgang Boos, Moritz Rittstieg

Managing Uncertainties in Life Cycle Evaluation of various Manufacturing Alternatives for a Product .................................................. 307
  D. Janz, E. Westkämper, S. Rahimifard

Product Development Strategy in Markets with Network Externalities ................................................................................................ 316
  N. Nishino, T. Takenaka, K. Ueda

Reference Model for IPS² Service Supply Chains ........................................... 324
  H. Meier, O. Volker

Production systems – special session: SPECIES .......................... 333

A Method for the Joint Design of Quality and Production Control in Manufacturing Systems ........................................................... 335
  M. Colledani, T. Tolfo

A novel method for the development of modular product architectures ............................................................................................ 343
  J. Pandremenos, A. Natsis, G. Chryssolouris

A Web-services oriented workflow management system for integrated production engineering .......................................................... 351
  K. Alexopoulos, S. Makris, V. Xanthakis and G. Chryssolouris

Cognitive Controlling Systems for Tolerance Optimization ................. 359
  R. Schnitli, C. Wagels, N. Maluschek, M. Isermann

Developing Sustainable Competitive Edge for Small to Medium Size Businesses through Realizing Agility ........................................ 367
  M. Gadalla, A. Deif

Development of a Manufacturing Equipment Configurator and an NC Simulator .......................................................... 375
  I. Németh, J. Pusztai

Evaluation of RFID implementation in manufacturing systems. A case study in automotive industry ........................................ 383
  I. Baffo, M. Carlino, G. Confessore, G. Stecca
Maintenance of Intralogistics-Systems – Introduction of the Pilot Installation “Log CoMo-Tec Lab” ................................................................. 391
   S. Wenzel, A. Wittzel, G. Bandow

Production System for the Automated Finishing in Die and Mold Making .................................................................................................................... 399
   C. Brecher, R. Tücks, C. Wenzel

Ramp-up of hybrid manufacturing technologies ........................................ 407
   F. Klocke, H. Wegner, A. Roderburg, B. Nau

Rule-based Engineering Change Mechanisms in Production Systems ........ 416
   R.C. Malak, J.C. Aurich

Simulation-based Assessment of the Productivity of Adaptive and Selective Production Systems ................................................................. 425
   C. Hermann, P. Haubek, J. Stehr, J. Kayasa

Step-NC Compliant Approach for Workpiece Setup Planning Problem on Transfer Line ................................................................. 433
   S. Borgia, S. Pellegrinelli, T. Tolio

Lean Engineering & Assembly ................................................................. 441

A new methodical approach to increase productivity in production-logistical processes ................................................................. 443
   P. Kuhlberg, T. Edtmayr, W. Sihn

Analyzing Production Systems: Combining Perspectives of ‘Process’ and ‘Work Activity’ ................................................................. 452
   Klaus-Peter Schulz

Development of a “convergent” order control for small and medium-sized production companies in the context of a turbulent market environment .............. 461
   E. Okhan, T. Denner, M. Schubert, W. Sihn

Lean process analysis in administration and production ......................... 470
   A. Schloske, P. Thieme

Measuring the Complexity of Manual Products Assembly .................. 478
   S.N. Samy, H.A. ElMaraghy

Optimization of the material flow using the principles of the Toyota Production System ................................................................. 488
   K. Tracht, J. Wrehde, T. Seuguue Kouamo
Table of Contents

Problems of Lean Production Implementation in the Croatian Enterprises.................................................................................................................. 496
   I. Veza, N. Gjeldum, L. Celent, N. Stefanić

Highly Extensible Life-Cycle Oriented Placement of the Order Penetration Point in International Supply Chains.................................................. 504
   Y. Uygur, B. Sieben, A. Kuhn

Using BPMN for Modeling Manufacturing Processes............................... 516
   S. Zor, K. Görtelch, F. Leymann

Value Stream Mapping for the Optimization of Maintenance Processes.................................................................................................................. 523
   K. Matyas, F. Hagmair, W. Sihn

Technology in production & logistics .................................................... 533

Automation of Driving Process in Copying manual Manipulations............. 535
   Z. Yang, F. Echtler, D. Scherer, M. Golfe, H. Hoffmann, G. Klinker

Cognitive Agent based Control of a Machining Shop.................................. 543
   H.S. Park, N.H. Tran, J.Y. Song, D.H. Kim

Development of Chatter Vibration Detection System utilizing Sensor-less Process Monitoring................................................................. 551
   Y. Sudo, Y. Kakinuma, T. Aoyama (2), K. Ohnishi

Hardware-Accelerated Measurement of Particle Velocities in Thermal Spray Processes.......................................................................................... 559
   L. Rockstroh, J. Hillebrand, W. Li, M. Wroblewski, S. Simon, R. Gadow

Identification of RFID Application Potentials in Manufacturing Processes........................................................................................................... 567
   M. Fallin, F.A. Gómez Kempf, J.C. Aurich

A comparison of the logistics performance of autonomous control methods in production logistics................................................................. 576
   K. Windt, T. Becker, I. Kolev

Monitoring of the Welding Station Cluster.................................................. 584
   A. Lebar, L. Sslak, D. Bračun, A. Sluga, D. Husenagić, P. Butaia
Knowledge management in production & logistics

A Knowledge Management Concept for Product Ramp-up in Automotive Industry
C. Herrmann, H. Bruns, P. Halubek, A. Wenda, S. Alltmor

Education in Industrial Automation in an Innovative Learning Factory
E. Carpanzano, A. Cataldo

Holistic Approach against product piracy
H. Meier, C. Siebel

Knowledge Flows in Early Stages of Product Development
D. Spath, L. Wagner, F. Goll, P. Oltihausen

Mastering Production Processes on the Basis of Management of Measurement Processes
R. Schnitt, J. Lose, M. Harding

Semantic integration by means of a graphical OPC Unified Architecture (OPC-UA) information model designer for Manufacturing Execution Systems
M. Schleifen, O. Sauer, J. Wang

Process modelling and process planning

A Distributed Routing Concept for Dynamic Flexible Flowshop Problems with Unrelated Parallel Machines
B. Scholz-Reiter, H. Rekersbrink, B.-I. Wenning

A methodology to support the design of multi-stage material separation systems for recycling
M. Colledani, S.B. Gershwin, T. Gutowski, M.I. Wolf

Analysis of NC data based on feature information model of shape and process for retaining machining information
F. Tanaka, S. Igar, T. Kaweguchi, M. Onosato

Assessment of an Organization for Digital Production Planning Validation with Axiomatic Design
M. Manns, K.-J. Wack

Automotive Supply Chain Flexibility Evaluation
D. Mourtzis, L. Rentzos and S. Makris

Cognitive Process Planning
B. Denkena, L.-E. Lorenzen, S. Krönig
Table of Contents

Empirical and Neural Network Modelling of Tool Wear
Development in Ni-Base Alloy Machining ........................................... 691
  C. Leone, D. D'Addona, R. Teti

Modelling and analysis of an autonomous control method based on
bacterial chemotaxis ............................................................................. 699
  B. Scholz-Reiter, M. Görges, T. Jagalski, L. Naujok

Modelling of Tool Wear in Gear Hobbing with Coated Tools for
Facilitating Process Planning .............................................................. 707
  K.-D. Bouzakis, S. Kombogianaris, E. Bouzakis

Production of a variable cross sectional profile from AHSS – A
sequential roll forming approach ........................................................... 717
  J. Paralikas, K. Salonitis, G. Chryssolouris

Routing model refinement in large-scale manufacturing
environment by using data mining ......................................................... 725
  D. Kamok, L. Monostori

The mathematical structure of CAPP within the software application
developed at FMT in Presov ................................................................. 735
  K. Monkova, P. Monka

Understanding and Improvement of the Piston Insertion Operation ......743
  Arnaud Robert, Serge Tichievitch

Utilization of a Bioinformatics Algorithm for the Comparison of
Process Chains ................................................................................... 751
  F. Reichert, A. Kunz, C. Bender, R. Morison, K. Wegener

Factory planning .................................................................................. 759

AMOR – An Agent for Assisting Monitoring, Optimization and
(Re-)Design in Factory Design ............................................................. 761
  D. P. Politze, N. Jufer, J. Batheil, A. Kunz, K. Wegener

Approach for planning of unit cost-optimal manufacturing and
transport systems ................................................................................. 769
  R. Schulze, A. Opitz, A. Krauß, E. Müller

Cross-Functional Digital Production Validation Framework for
Automotive Industry ............................................................................. 779
  J. Klefer, M. Manns, K.-J. Wack

Energy Efficiency at Manufacturing Plants – A Planning Approach ......787
  E. Müller, T. Löffler
Participatory Design of Communication and Information Flows in Plant Layouts..........................................................795

D. Jentsch, D. Menzel, R. Riedel, K.-P. Schultz

Production planning ..............................................................803

A Key Performance Indicator System of Process Control as a Basis for Relocation Planning........................................805

F. Reichert, A. Kunz, R. Morison, K. Wegener

A proposal of socio-inspired manufacturing scheduling concept and its application into flexible flowshop........................................813

T. Kaikura, N. Fujii, S. Toide, H. Ishibashi, T. Nakano

An approach to avoid collisions in sheet metal forming during early stages of production planning...................................................821

D. Metz, M. Grauer, O. Reichert, W. Schäfer


J. Malte, P.F. Cunha

Assessment of Products Eco-Efficiency for the purpose of Eco-Design......................................................................................837

Snezhana Kostova, Peter Mitrouchev and Nonka Georgieva

Collaborative Planning with Dynamic Supply Loops .........................844

P. Egni, A. Döring, T. Timm, J. Váncza

Considering Worst-case Scenarios within Final Assembly Planning......852

L. Weyand, H. Bley

Efficient Phase-Out Planning by Alignment of Lot Sizes in Supply Chains..................................................................................860

F. Hertrampf, R. Nickel, P. Nyhuis

Exploiting Repetitive Patterns in Practical Scheduling Problems........888

A. Kovács, J. Váncza

Flexible and Autonomous Production Planning Directed by Product Agents.................................................................................876

M. Matsuda, N. Sakao, Y. Sudo, K. Kashiwase

Hybrid evolutionary optimization in efficient assembly task planning.....884

T. Jankowski, J. Jędrzejewski

Improved logistics performance through the use of locked flexibility potentials ..............................................................................892

K. Windt, O. Jeken, F. Arbabzadeh
Table of Contents

Integration of Personnel and Production Programme Planning in the Automotive Industry .................................................. 900
  S. Auer, T. Winterer, W. Mayrhofer, L. März, W. Sihn
Long-term Capacity Planning in the Shipbuilding Industry .................. 909
  M.-C. Wanner, J. Sender, U. Kothe, R. Bohnenberg
Inventory Allocation with Consideration of Component Commonality and Risk Management ............................................... 917
  A.M. Radke, M.M. Tseng
Methodology for Structure-Analysis of Automotive Manufacturing ......... 925
  C. Loffler, A. Lakeit, E. Westkämper
Process Harmonisation in Digital Manufacturing ................................ 933
  J. Schallow, D. Petzelb, J. Deuse
Product Variety in the Brazilian Cosmetic Industry .......................... 941
  L.F. Scovarda, A.C. Reis, S. Braffmann, H. Winkler
Leveling of Low Volume and High Mix Production based on a Group Technology Approach .............................................. 949
  F. Bohnen, J. Deuse
Rolling Horizon and online optimization in discrete lotsizing production ................................................................. 957
  W. Dangelmaier
Simulation-based, energy-aware production planning ........................ 964
  S. Chiotelis, N. Weisert, G. Seliger

Total Quality Assurance, Productive Maintenance ............................. 973

An Approach to Workflow Based Quality Management ........................ 975
  D.C. ten Dam, D. Lutters
An efficient use of quality engineering techniques for analysis and improvement of industrial processes ................................. 983
  V. Majstorovic, T. Sibalić
Determination Of The Overall Equipment Effectiveness For Assembly Systems On The Base Of Product Data ............................ 991
  R. Neugebauer, D. Kreppenhofer, T. Langer
Transparency in Production by Sensor Equipped Molds and Dies .......... 999
  R. Schmitt, M. Harding, J. Lose

XVI
ICT in production & logistics

Design and Analysis of A Simulation, Monitoring and Control System of 4-DOF Modular Reconfigurable Robot

D. Zhang, J. Lei

A Robust Multiple Logistic Objectives-oriented Manufacturing Control (RMLOG)

K. Windt, B. Scholz-Reiter, Huaxin Liu

Achieving Distributed Control Applications Using IEC 61499 and Communication Standards

G. Morán, F. Pérez, E. Estevez, D. Orive, M. Marcos

Agent-based Simulation Modeling of an Interaction Mechanism for Detailed Design of Autonomic Manufacturing Execution Systems

Milagros Roión, Ernesto Martinez

CAM System Development for Multi-tasking Machine Tools

T. Kotani, K. Nakamoto, T. Ishida, Y. Takeuchi

Sensible Ergonomics Network in Smart Environment (SENSE) — A Step to Human Safety and Productivity Sensitive in Smart Factory

C.F. Kuo, M.J. Wang, C.H. Su

Implementation of practice-oriented IT Frameworks for knowledge based configuration and design of customised products

C. Lutz, D. Gerhard

iPod touch – an ICT tool for operators in factories of the future?

T. Fässberg, G. Nordin, A. Fasth, J. Stahre

Lightweight IT support for ad-hoc-processes in production and logistics

Martin Böhniger, David Jentsch

Modular INFEELT STEP; An Integrated and Interoperable Platform for collaborative product development based on STEP Standard

O. Fattahi Vallilae, M. Houshmand

Seasonal Demand on the Array of Spare Parts in the Aviation Industry

K. Tracht, P. Schuh, F. Weikert

Production Simulation in Virtual Worlds

S. Seitz, M. Hermann, D. Wimpff

Rule based Expert System with Quality Control Charts to support a Logistic Strategy on Operational Level

M. Elsweier, P. Nyhuis, R. Nickel
Table of Contents

Introducing SOA into Production Environments – The Manufacturing Service Bus .................................................. 1117
   J. Minguez, D. Lucke, M. Jakob, C. Constantinescu, B. Mitschang, E. Westkämper

Wireless Field Bus Communication with UWB for Manufacturing Environments ...................................................... 1125
   M. Masini, M. Jakob, M. Berrott
Impact of influence factors on logistics planning in the Automotive Industry

D. Palm¹, W. Sihn (2)²

¹ Fraunhofer Austria Research GmbH, Theresianumgassee 7, 1040 Vienna, Austria
² Vienna University of Technology, Theresianumgassee 27, 1040 Vienna, Austria

Abstract

Logistics planning in the Automotive Industry has a variety of tasks with a strong impact on the resulting cost of a car. Especially during the vehicle development phase before the start of production (SOP), the logistics planning determines the resulting costs and the flexibility of the logistics system in the production phase (after SOP).

Influence factors on the logistics system are constantly changing not only during planning but also in the production phase. The paper examines the nature of these influence factors and the impact of changes on the logistics system during the planning and the production phase.

It can be noticed, that some influence factors and changes are neglected during production phase what can lead to a non-optimized logistics system with higher costs than necessary. Therefore a new holistic planning model is introduced.

Keywords:
Logistics planning, automotive industry, integrated planning

1 INTRODUCTION

The effective planning of logistic systems is an undisputed success factor in any given company. In the automobile industry in particular, planning quality is a massively cost relevant factor. In the modern automobile production, logistics account for about 10% of the costs entailed in the product price – the majority of these costs are specified within the product development process before the Start of Production (SOP).[1]

The planning process and with that the determination of planning objects begins up to 80 months before serial start, depending on planning complexity and manufacturer.[2] This lead time to the actual serial production is followed by a period between five to seven years of production during which the logistics system is maintained unaltered for the most part, bringing the total time frame of the logistics system to up to10 years.
Changes in the logistics system and of the framework conditions can be divided into internal, external and global factors of the two main processes in automotive industry – the product development process and the production process.

Main purpose of this paper is to look at changes and influence factors of the logistics system of automotive manufacturers (OEM) during the planning and product lifecycle, identify a possible impact on the logistics system to find an answer if the planning aim – to minimize logistics costs – is still fulfilled.

2 AIMS OF LOGISTICS PLANNING AND INFLUENCE FACTORS DURING PLANNING STAGE

Logistic planning involves the development, evaluation and selection of concept alternatives for the future design and optimization of logistics systems and logistic processes.[3]

![Diagram](image)

Figure 1: Connection between production readiness of the logistics system and possibility to influence logistics costs

The aim of a logistic planning process is primarily geared to maximizing logistic performance, while simultaneously minimizing logistic costs.[4] The fundamental goal setting is thus the economic planning of logistics systems, that explicitly includes the influence on the product from a logistic perspective.[5] Thus, the logistics planning must kick-off at an early planning stage, where the possibility to influence costs is highest. On the other hand, these are moments in which the maturity of the product, the logistical network and processes are however minimal.[6] (Figure 1).

Multiple run-through's of the steps involved in the planning process are mandatory, due to assumptions, which have to be made at the beginning of the planning process and are altered or modified in the course of the planning process. Given the complexity of an automotive network that includes suppliers, service providers and manufacturers, a complete methodical support across departmental and company borders is a prerequisite for securing quality in the planning process. Most especially due to the high number of planning partners comprising of suppliers, external service providers, transportation planners, structural or resource planners, all with individual targets. As an example the supplier regards his own production container as optimal, since he has not to change it for the OEM. From a transport perspective the container that optimizes the corresponding dimensions of truck capacity is optimal. From a handling perspective within
an OEM manufacturing plant, the largest possible available container contributing to effort reduction and from an assembly perspective as the smallest available container contributing to minimizing the capital tied up and optimizing the bundled utilized buffer space.

The logistics planning process must therefore while taking account of the interdependence of influence factors, implement and align the company objectives within the logistics system. The result of a logistics planning process can therefore only be a total optimum within the system limits. For sub-systems no specific optimum will be targeted, if this does not lead to an optimum for the entire system as a result [7].

For multiple-staged, multiple-structured logistic systems, such as in the automobile industry, with different companies and associated companies goals and as such with a large number of independent decision makers, interest balancing and cooperative solutions have priority. The optimization process starts with the function optimization of the individual sub-systems and then on to the entire system. This requires continuous feedback with the performance of all stakeholders in the logistic chain, which includes suppliers, manufacturers, external logistics service provider all the way to the customer [7].

The dynamics during the whole planning phase by the three factors of influence (internal, external and global, see Figure 2) is therefore usually high. But the planning process has to take alterations into consideration and until the end of the planning process the planning result aims to a global optimum integrating these changes. Assuming that the result of the planning process is optimal, the logistics system can be considered as optimal at the end of the planning process.

![Figure 2: Influencing Factors on the Logistics System](image)

3 DYNAMICS WITHIN THE LOGISTICS NETWORK AND OTHER EXTERNAL OR GLOBAL FACTORS

The structure of logistics networks in the automobile industry is to a large extent a reflection of the complexity of the cars produced. The most diverse companies are networked with one another through several overlapping and in themselves interpenetrating enterprise networks. Sydow describes company networks in the automobile industry as complex poly-
centric systems, that are regulated over several hierarchically structured
control centers [8]. Each supplier has in addition a supplier network, which
as a rule increases in complexity with each corresponding higher level in
the value creation chain.

Each of the companies is however embedded in the networks of other
companies and the automobile industry can thus be understood as a net-
work of networks. The supplied parts are mostly specifically designed to
the needs of the purchasers and can therefore usually not be alternatively
used, this specificity increases downstream in the value creation chain.[9]

These complex networks not only have a great dynamism but also a great
impact on the logistics system. Changes such as in the delivery location of
a supplier have major implications for the time schedule and the corre-
responding delivery form (Warehousing, Just-in-time supply or direct deliv-
ery), the transport chain, the inventory level within the manufacturing plant
etc.

Other external influence factors have to be searched for within the market.
Here are notably: competition, changes in client needs and demand fluc-
tuations, that from logistical perspective result in quantity alterations of
purchased and delivered parts or of finished cars for distribution. In par-
ticular in the procurement process quantities of parts are highly relevant
planning parameters, which also substantially influence planning related
outcomes.

So influence factors on a structural level (supplier location as source) as
well as on parameter level (quantities) are critical for the costs of a logis-
tics system.

A further area addresses the factors of influence that Gudenus categorizes
under "environment" and "law"[10] Changes in this area have varying
effects on the logistics system. The general introduction of a truck-toll
(Vignette) generally has a cost increasing effect, without however having
an influence on the outcome of the planning process. The introduction of
distance dependent transport costs would on the contrary alter the plan-
ning process outcome to favour less remotely located suppliers.

An also very extensive area is within the field of "technological progress".
This can refer to technological changes within the field of logistics (IT
systems for tracking and tracing, ordering, RFID systems for material flow
tracking), technological changes within the product field (battery packages
for Hybrid motor units), or even the availability of newer planning systems
within logistic planning process itself (digital factory models). In practice,
these changes, as far as they must not be rapidly implemented due to
legal reasons, are in most cases curtailed for the next planning cycle.

So it can be noticed that some external or global influence factors have
no, others a general impact (cost increasing for the whole system but not
result changing) and others a specific influence with result changing char-
acter. In practice the latter means, that higher logistic costs then neces-
sary incur, when the logistics system experiences no adjustments.
4 DYNAMICS WITHIN THE LOGISTICS NETWORK AND OTHER EXTERNAL OR GLOBAL FACTORS

Gudehus divides the internal influence factors on the planning process into product, process and production, structure and area, employees as well as business strategy. With a direct connection between product and the logistics planning process. The production is the customer of procurement logistics and each product alteration also simultaneously brings about an adaptation in logistics process. Here processes of phase in and phase out of parts in serial operation are established and also the parallel product development and logistics planning process during the product development process generates a direct connection with a mutual influence. However, this feedback only curtails for physical product changes. Deviations to the planning assumptions such as those involving part variants have from logistical perspective a significant impact. The decision on sequenced delivery of parts, depends greatly on the number of variants of the respective part.

There is a similarly close connection between the production process and the logistics system to another - a change in the order of production or in the position of the assembly of a part on the assembly line, inevitably brings about a re-planning of the logistics system because the position of line-side presentation of the part at the assembly line changes.

Nevertheless, as mentioned before, the number of units produced per unit time unit is also logistically massively relevant to the planning process - here however there are often no adjustments made to the logistics system. Reason for this absence of adaptation can be found in the lack of knowledge at what specific quantity other forms of supply are more cost effective than the existent one.

Structures and areas are undergoing permanent alterations in assembly plants. In particular in manufacturing plants in which several different models are parallel produced, not only new or dis-continued models but also current serial production is modified due to the re-planning process.

Employees naturally have a considerable high degree of dynamism not only within companies in general as a resource but also in logistics planning process with their experience and knowledge. In the long term the performance potential of the company is determined by the regulation of staff capacity in the various areas of the company. There may be adjustments such as in the shift models, which usually also lead to re-planning the logistics system. The planning knowledge in the logistics planning process is mostly documented in planners specification guide, where results of the planning in the form of service concepts or within the planning system are also documented. Some studies in the recent past focus on improving planning outcomes through appropriate planning knowledge management systems in order to achieve a sustainable improvement in planning quality and to anchor the know-how of planners within the company.

The company strategy and the company goals play a great role in the general design of the logistics systems since the logistics objectives are derived from the company objectives. Thus, a change in the aims of the
company also leads to a corresponding alteration of the logistics objectives and systems. The changes are not in reference to individual elements of the logistics system but rather in reference to long-term changes in the product, production program or sourcing strategies.\(^{[12]}\)

5 CONCLUSIONS

In conclusion, it can be said, that the dynamism of the factors of influence during the planning period and the process of serial production is very high. These changes are systematically included in the system design during planning phase in the vehicle development process. During production process only specific relevant changes lead to changes in the logistics system. Other relevant changes are neglected in operative practice. Adjustments are in particular made, where the physical material flow is changed and as such makes re-planning an inevitable necessity. Otherwise in the operative practice, a worst-case scenario is formed and this determines the interpretation of the logistics system. It sets the maximum number of produced cars per time unit, the theoretically possible number of variants per part, the maximum space requirements. This inevitably results in a sub-optimal condition with respect to the cost objectives of the logistics system.

In the analysis of the scientific literature on the logistics planning for serial production it is noticeable that a holistic view on the whole lifecycle from planning over start of production to production process until end of production is not used very often. Schneider is stating, that the logistic planning process in the product development process significantly less space, as the planning in serial operation.\(^{[13]}\) Scheuchl\(^{[11]}\) empirically examines how various factors influence the planning process, the dependence of the quality of planning on planning triggers and factors of influence and introduces a planning environment, which makes it possible to make scenarios to forecast some effects, the feedback of influences in the production phase to the logistics system is however not explicitly envisaged.

Dürrschmidt\(^{[14]}\) suggests a model, in which the scenarios for influence criteria in the planning stage are defined in terms of variants, quantity flows or logistics performance metrics and pre-planned. During the operational phase options of choice between different predefined logistics systems can be made. If not pre-planned, parts or the whole system must be re-planned. He as such combines planning and operational phases in a holistic adaptive model. This model is however very general and is not based on the logistics planning process of the automobile industry.

That is why it can be said that existing methods of the logistics planning process in the automobile industry only inadequate curtail for the dynamism of the factors of influence during the planning and the serial operation.

The present paper shows on the one hand the necessity and relevance of methodical logistic planning in the automobile industry over the entire life cycle of a vehicle and on the other hand the deficits entailed in the known models. A holistic integrated planning must have the following features:

- ability to provide methodical support from the commencement of planning before SOP to the end of production (EOP).
ability to take into account the dynamics within the environment and adaptively react to changing factors in planning processes before SOP as well as during serial process.

Thus the following model for integrated adaptive logistics planning shall be introduced (see Figure 4):

Figure 3: Integrated Logistics Planning

The product related logistics planning spans from start of product planning over the start of production to end of production and includes the planning of after sales parts and structures after the production cycle of the car. It contains not only planning activities in the product and production development phase but also in the prototyping (ex. provision of prototypes) and ramp-up-phase (ex. adjustments in the logistics system as result of the try-out production). During the product development phase, a repository with all planning premises, methods, processes and data is held and constantly updated due to changes internally and externally. The planning phase reacts adaptively to the internal and external influence factors.

During the planning, several states in the lifecycle of the production process in terms of production quantities, variants and significant changes in structure of the plant or plants are pre-planned (ex. introduction of a new derivative or model in the plant with impact on space, material flow or structure). Each scenario has not only a planning result but also a validity concerning the main parameters of the planning (ex. part geometry, number of parts, number of variants, supplier etc.). This validity is transferred to a repository for the production phase.

During production this main figures are monitored. In cases of a deviation, either a switch in an appropriate pre-planned scenario is executed or a re-planning initiated. This leads to an integrated adaptive logistics planning which fulfills all above mentioned demands.

6 REFERENCES


