The Need for a Structured Approach towards Production Technology Roadmaps in Innovation-driven Industries

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ZF Friedrichshafen AG

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### Agenda

1. Innovation in context of production
2. Technology Roadmapping: lack of investigations
3. Technology Roadmapping in automotive
4. Technology Roadmapping: unexploited potential
5. Technology Roadmapping Pilot Project
6. Summary and Outlook
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Innovation in the context of production
Holistic view of the production environment

- Environment of uncertainty and rapid change
- Big dependencies:
  - OEMs
  - Product engineering
  - Costs
  - …
- Shorter innovation cycles
- Fast technological progress
- Competition: cost and time pressure
Innovation in the context of production
Requirements for production planning

Production context requires:
- Establishment of an effective technology management
- Traceability in innovation planning from the point of view of the production
- Reliable decision support for production planning
- Needs-driven technology planning process

→ Roadmapping as production planning tool
Innovation in the context of production
Production planning: Major input sources for technology roadmaps

Internal inputs / requirements
- Strategy
- Foreign locations

External inputs
- Global megatrends
- Technology screening

- Cyclical planning process
- Activities are embedded in a constantly updated process
- Integrated roadmapping: connected with all stakeholders

Bottom up
Requirement analyses

Top down
market product trends strategy
Innovation in the context of production
Objectives for a holistic production planning by roadmapping

- Identifying current trends of market, products and technology
- Identifying potential technologies
- Planning detailed R&D project schedule
- Understanding Company's vision and strategy
- Communicating with other business units (e.g. marketing, manufacturing, product engineering, purchase)
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Holistic integrated technology roadmapping

Need for research

General aspects:

- Roadmapping process typically neither systematic nor transparent
- Difficult to keep the roadmapping process ‘alive’ on an ongoing basis
- Investigations have no basis of theoretical foundation
- Which factors need to be considered from the communication point of view in roadmapping?
- Roadmapping methodology is specified for one industry sector → can not be commonly used by all companies in all industries

Production specific:

- Necessity for systematic and integrated roadmapping with a specific focus on production industries
- Lack of integration of product roadmaps and production technology roadmaps
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### Context: Suppliers to the automobile industry

**ZF Corporate Structure**

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<th>Division T</th>
<th>Car Powertrain Technology</th>
<th>Car Chassis Technology</th>
<th>Commercial Vehicle Technology</th>
<th>Industrial Technology</th>
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<td>CEO</td>
<td>Automatic Transmissions</td>
<td>Chassis Systems</td>
<td>Truck &amp; Van Driveline Technology</td>
<td>Off-Highway Systems</td>
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<td>Manual Transmissions / Dual Clutch Transmissions</td>
<td>Chassis Components</td>
<td>Axle &amp; Transmission Systems for Buses &amp; Coaches</td>
<td>Test Systems</td>
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<td>Axle Drives</td>
<td>Rubber &amp; Plastics</td>
<td>CV Chassis Modules</td>
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<td>Powertrain Modules</td>
<td>Suspension Technology</td>
<td>CV Damper Technology</td>
<td>Marine Propulsion Systems</td>
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<td>Die Casting Technology</td>
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<td>CV Powertrain Modules</td>
<td>Aviation Technology</td>
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**Corporate Finance, IT, M&A**

- Corporate Human Resources
- Corporate Governance

**Corporate Production**

**Corporate Materials Management**

**Corporate Quality**

- Electronic Systems

**ZF Services**
Context: Suppliers to the automobile industry
ZF Division T: Commercial Vehicle Technology

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<td>TC</td>
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Context: Suppliers to the automobile industry
ZF Division T: Commercial Vehicle Technology

More Than 20 Production Locations Worldwide

Approx. 14,400 employees worldwide
ZF Division T: production roadmapping
Stakeholder

Production Roadmap

Market / purchase

Product engineering

Technology development:
technology research / projects

Production management
ZF Division T: production roadmapping

- Annual update
- Relevant production topics for specified planning interval and strategic importance
- Alignment with technological resources and business goals
- Exchange of explicit and tacit production knowledge
Production roadmapping in large companies need for research

Integration of stakeholder (product engineering, purchase, production) / involvement of many experts → networking

Suitable methods: Portfolio, innovation workshops, idea management, trend management, ...

Tracable, structured, dynamic, connected, reliable process

Intern inputs / requirements
- Strategy
- Foreign locations

Extern inputs
- Global megatrends
- Technology screening

Bottom up Requirement analyses

Top down market product trends purchase strategy

Production Roadmap
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Roadmapping unexploited potential communication tool / frequent interactions

Phaal: TRM (Technology Roadmapping) on the basis of classical communications theory

- The stronger the willingness to cooperate with users / reduce the uncertainty associated with TRM forecasts, the more credible TRM becomes
- The more often the communication between a TRM development team and TRM users, the more credible a TRM becomes
- The more TRM users perceived TRM outputs as credible, the more TRM utilization increases
- The more the written / face-to-face channel is used as the main form of communication between the TRM development team and TRM users, the more credible a TRM becomes

TRM Utilization

TRM Credibility

Extent to interaction

Channel perspective

willingness to cooperate
willingness to reduce uncertainty

written channel
face to face channel

TRM team

TRM user
Roadmapping unexploited potential
communication tool / frequent interactions

- RM as communication tool (Willingness to cooperate)
  - Effective information management
  - Keep up a close relationship between technological resources and business goals
  - Enable the exchange of explicit and tacit knowledge (→ creates new knowledge)
  - Enable frequent interactions between the TRM development team and TRM participants
    → A high level of interaction improves the credibility of a TRM
  - Integration of participation of the problem owner, solution provider, customer, and other stakeholders
    → Integration of experts from different but related fields
Roadmapping unexploited potential building consensus

- RM as process for building consensus (extend to interaction)
  - Integrates existing management
  - Organizations / Researchers perceived to be cooperative
  - Reaches a consensus on a specific issue
    - Participation of experts with particular knowledge and skills in collecting, processing, and integrating this multidimensional information
    - Derive a consensus on the technologies that will be necessary to meet demand
Roadmapping unexploited potential decision-making

- RM as process for decision-making (willingness to reduce uncertainty)
  - improve the capability to manage its own technologies by
    - clear and specifically meaningful research results: acceptability, feasibility, and the quality of information
    - persuasive rationale during the planning stage
    - rational and scientific techniques within the roadmapping process
  - improve the strategic and long-term R&D planning by
    - Intensive communication among members at the interface of the R&D and marketing sector → cooperation between R&D and Marketing
    - coordinating research activities
    - Integration of product roadmaps and production technology roadmaps → cover complementary and mutually dependent aspects
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Technology Roadmapping Pilot Project

Objectives

- Improvement of the Innovation Management in Production in the T Division

Focus:

- Trend Management: Derivation of Consequences of global Megatrends for the Production
- React on Future Challenges for the Production timely by structured Trend Investigations

Integration of the point of view of Product Development, Purchase, and Production required!

Additional points of view, expertises, and competencies necessary, depending on the investigated topic
Moderated interactive Workshops with Guided Idea Generation
Insights into Selected Pilot Project Results

- Running through the first Funnel, departing from (Mega-)Trends in Technology, Society, etc.
- Selection of three Trends with particular relevance for Production Technology
- Flexagility
  - Glocalisation
  - Hybridisation

- Guided Idea Generation for these Trends
- Consolidation of the Ideas in 5 Clusters
- First Prioritisation of Ideas based on the Criteria
  - Organisation
  - Costs
Insights into Selected Pilot Project Results

- Running through the second Funnel departing from the consolidated Ideas of previous Workshops
- Selection of Idea Clusters
- Generation of Questions related to these Clusters („?“)
- Selection of concrete Topics within these Clusters
- Idea Generation:
  - Elements of answers to all questions related to the Clusters („!“)
- Derivation of Requirements for the third Funnel
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Summary and Outlook

- Technology Roadmapping is an increasingly important Decision Support Tool for the Strategy Development in Industrial Organisations.

- In many organisations, however, the real potential of Technology Roadmapping is still unexploited, mainly due to lack of regularity, traceability, and integration of stakeholders.

- Technology Roadmapping requires the regular close cooperation among different expert groups inside and outside the organisations.

- Implementing this close cooperation ("integration") is one of the most difficult challenges in today's Industrial Organisations.

- Therefore, the added value implementing a well-functioning Technology Roadmapping Process lies not only in the result of roadmapping, but also in the experiences gain along the process itself ("The way is the target").

- Our particular focus is to find the right equilibrium between the structure and dynamism of the process, leveraging the integration and active participation of several stakeholder groups for reliable and traceable integrated Technology Roadmaps.
Thank you for your attention!