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An SME Transition from Plan-Driven to Hybrid Project Management with Agile Software Development Methods

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Motivation & Goals

Motivation:

- Small and medium enterprises typically need to align plan-driven (heavy-weight) and agile (light-weight) software development processes.
- Main goal is to enable high flexibility (e.g., considering frequent changing customer requirements) aligned with a plan-driven approach (e.g., defined by contracts), i.e., some hybrid approach to benefit from both engineering processes.
- Process Improvement Initiative

Key research questions focus on:

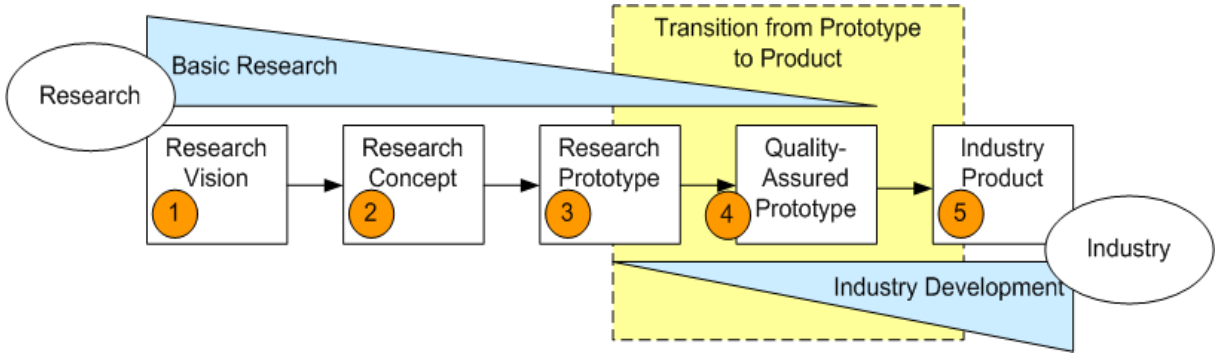
- How to enable the alignment of plan-driven and agile engineering processes?
- What are the benefits of such a hybrid approach?

Goals of the paper:

- Concept of a hybrid project management approach.
- Lessens learned and success-criteria of a successful transition and application of the modified approach based on two case studies.

Related Work

- Plan Driven Project Management
  - Widely spread in industry because of defined plans.
  - Separation of individual phases (including quality assurance steps).
  - Require stable requirements with limited capability of changes.
- Agile Project Management
  - Growing importance in the last decade of software development.
  - High level of customer interaction and collaboration.
  - Flexibility regarding requirements changes.
- However, new product development projects typically require both, from research prototypes to industry products*.

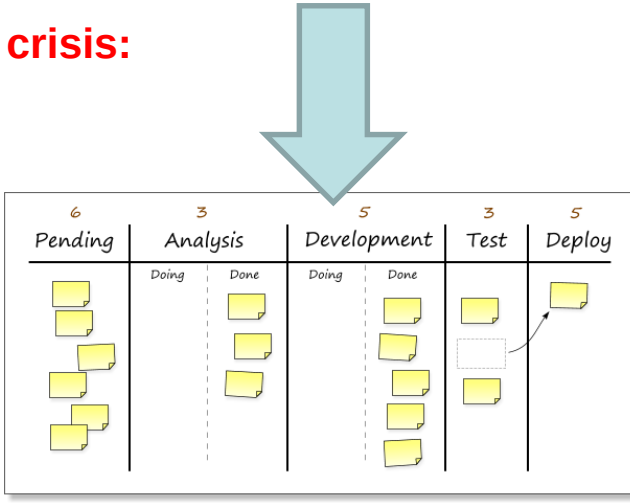


Winkler D., Mordinyi R., Biffl S.: "Research Prototypes versus Products: Lessons Learned from Software Development Processes in Research Projects", Proc. of EuroSPI, 2013.

Crisis with a Plan-Driven Approach (Project A)

- Project Goal: New product development, designed for safety-critical certification.
- Challenges & Risks:
  - New / unknown application domain and technologies.
  - Limited resources: 9 engineers
  - Estimated effort: 30 person years.
  - PM-Approach: Strictly plan-driven

- **Intermediate Management Review after 60% → project crisis:**
  - Project targets are moving away from completion.
  - Unexpected and frequent feature requests.
  - Inefficient project and process tracking and tracing.
- Counter measures → make the best out of the situation:
  - Changing the PM-approach towards agile.
  - Supported by external consultants (e.g., by using Kanban)



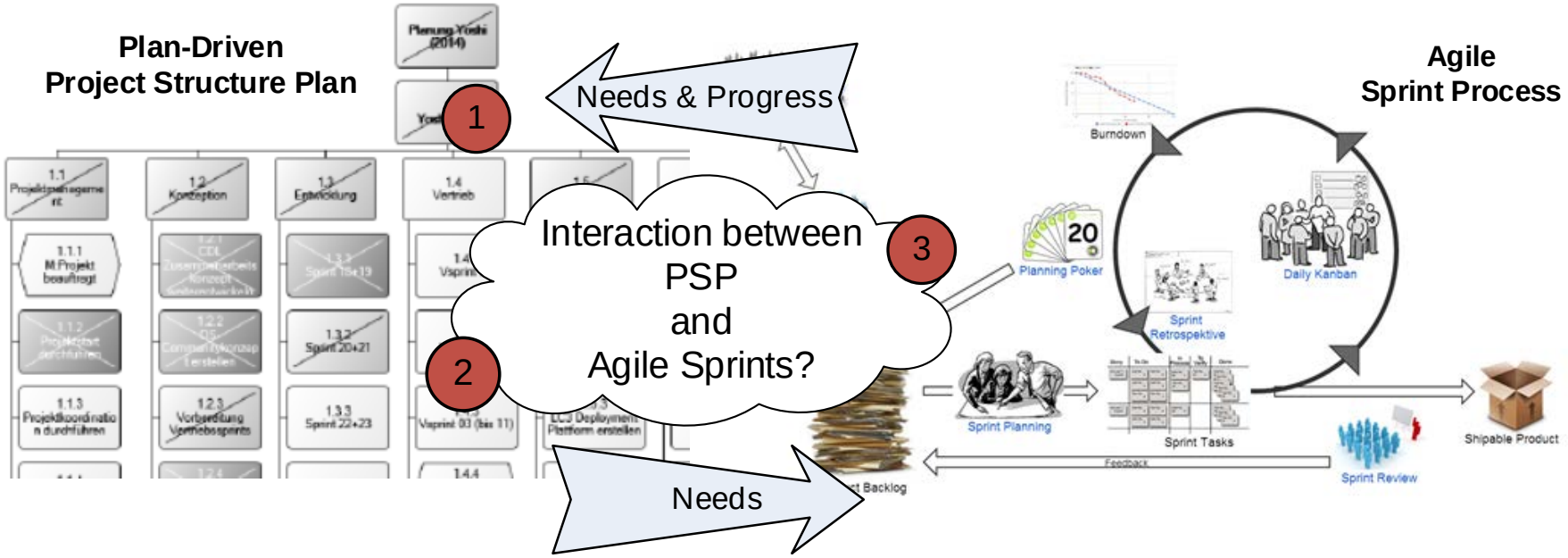
- Results:
  - The project could be finished successfully but with reduced functionality.

Changing the PM Strategy

- Focus on Best-Practices out of two worlds:
  - Plan-Driven Approaches: structure and basic roadmap
  - Agile and flexible Approaches: development sprints based on agile principles.

- Research Questions
  - How to combine best practices from plan-driven and agile PM approaches towards a hybrid approach?
  - How to demonstrate the benefits of the hybrid approach?

Hybrid Project Management Approach



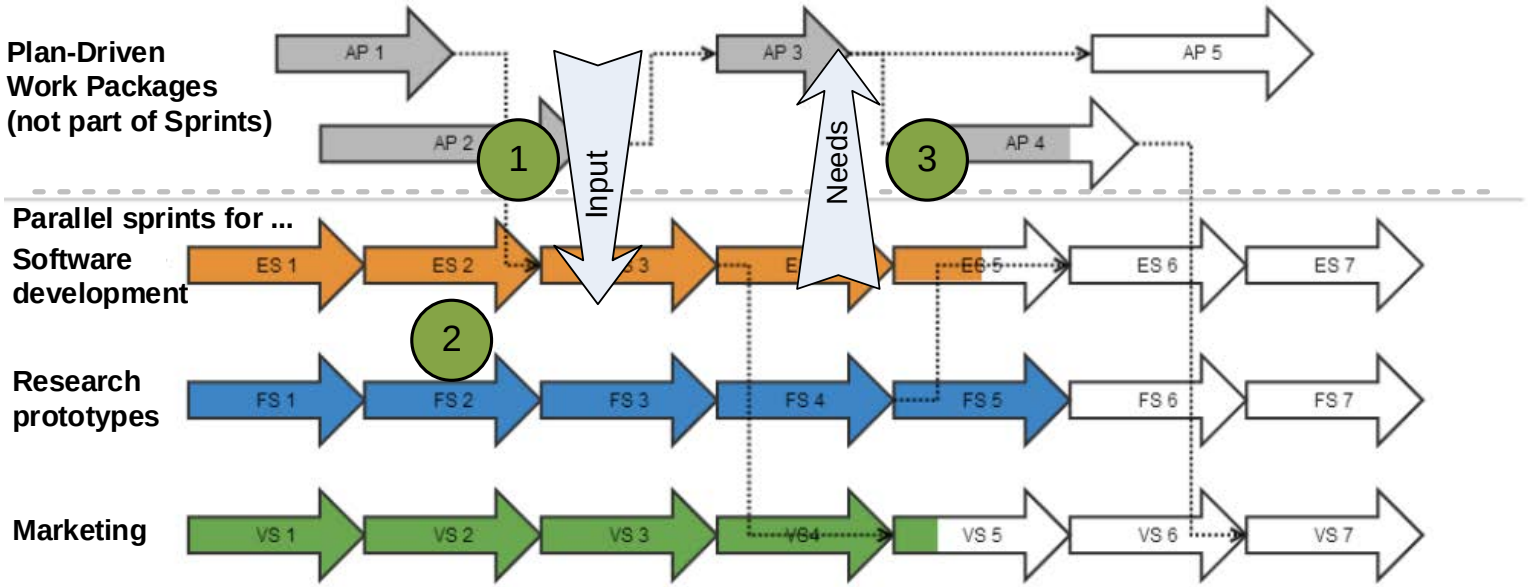
1. In the plan-driven project structure plan (PSP) the agile sprints have to be represented for planning, coordination, controlling, and measurement of progress;
2. The process interface between PSP and sprints has to be defined; and
3. In the sprint backlog the needs coming from other work packages in the PSP have to be represented for effective coordination.

Case Study with the Hybrid PM-Approach (Project B)

- Project Goal: Software Development Environment for Automation Systems Software Design & Development (Logi.cals Open 3).
  - Software Research and Development Project
  - Engineering system in a systems-of-systems multi-disciplinary engineering environment to develop industrial production plants.

- Challenges & Risks:
  - New / unknown application domain and technologies (again a challenge)
  - More but still limited resources: 20 engineers from different organizations
  - Estimated effort: 3 years with yearly major deliverables to key customers.
  - PM approach: hybrid project management
    - Plan-Driven top-level framework
    - Agile Sprints

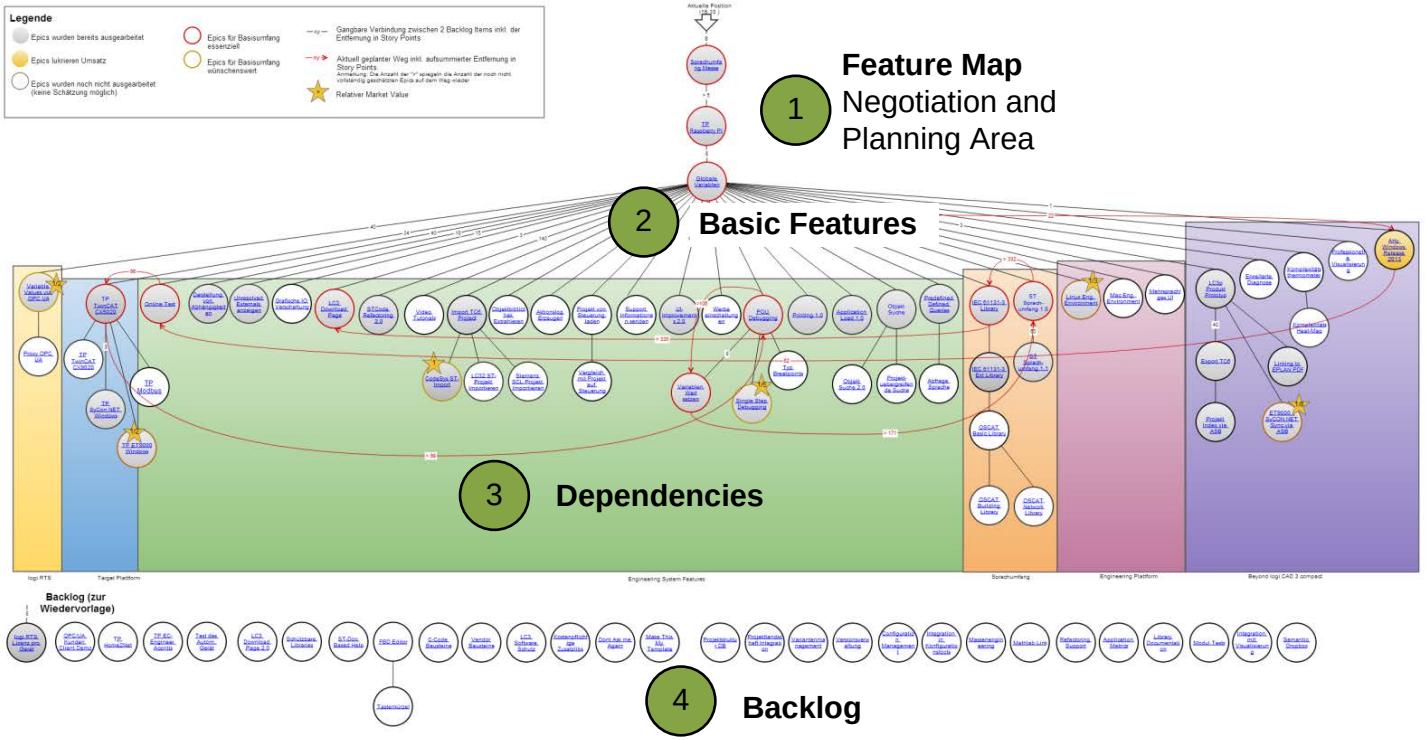
Interaction of Agile / Non-Agile Work Packages



1. Plan-Driven PM. Basic project management framework, e.g., technology exploration, training, concept development → stories/sprints.
2. Parallel Sprints. Individual sprints aligned with plan-driven work packages. Parallel sprints for software development, research prototypes, marketing → simplification of communication.
3. Synchronization. Needs coming up from sprint tasks get communicated to the PM and get planned in plan-driven WPs.

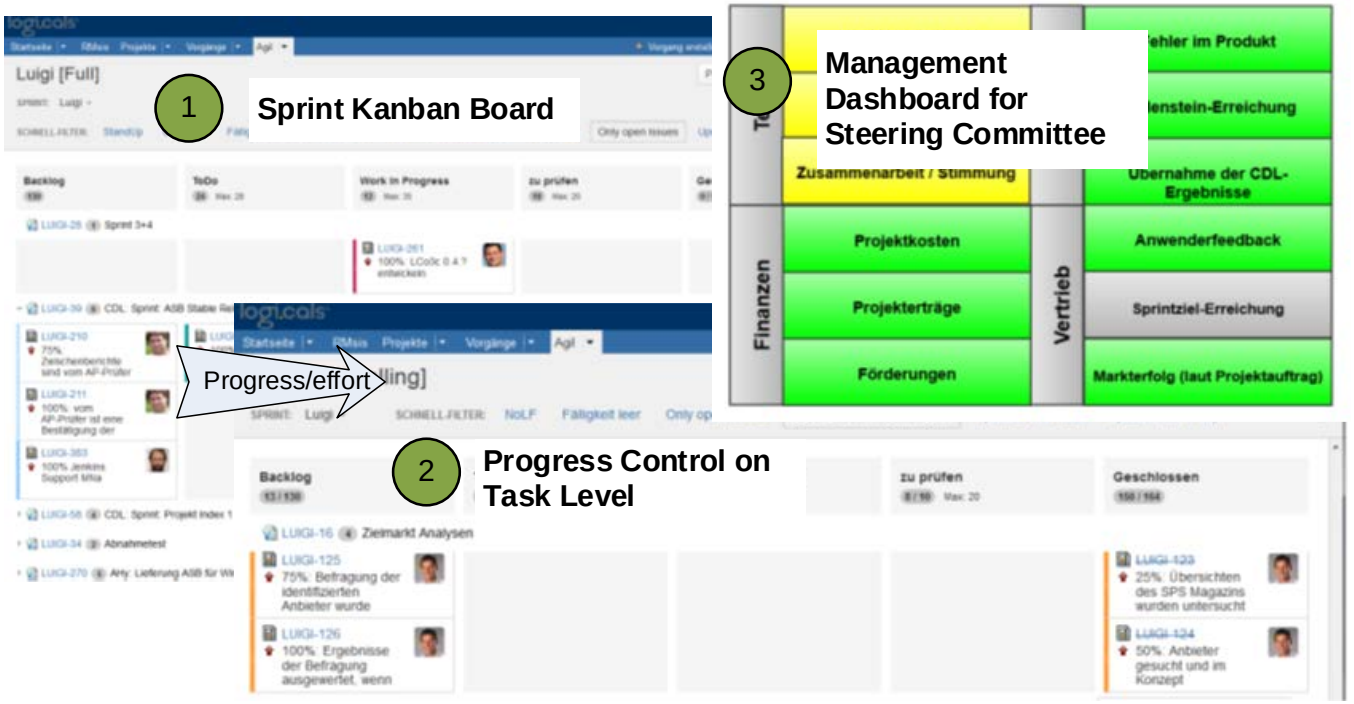
Legend: AP .. Work Packages; ES: Engineering / Development Sprints; FS: Research Sprints; VS: Marketing sprints

Balancing the Software Development Process



1. Feature Map. Epics and stories driven by marketing and research; concrete requirements or innovative ideas → dependencies become visible.
2. Basic Features are planned for shipment to the key customers → (Research) Prototypes.
3. Dependencies. Selected features sets for different versions of the product (different colors)
4. Backlog holding ideas as candidate for future development (not planned yet)
   → Foundation for Sprint planning.

Tool Support



1. Sprint Planning. Kanban boards, used by the development team, to organize the work tasks in sprints, showing the work load of resources and progress control.
2. Plan-Driven progress control. Kanban boards also provide for the project management progress control on task level from sprints.
3. Management dashboard. The data from the Kanban boards is aggregated in the bi-weekly project team meetings for controlling to allow the effective and efficient update of the management dash-board for reporting.

Project Risk Assessment of the Case Study Projects

Risk Items	Risk Ratings		
	Project A	Project B	Risk Change
Environmental Risks			
E-Tech. Technology and certification process uncertainties.	3-4	3	-
E-Coord. Stakeholder diversity leading to conflict and misunderstandings.	2	2	~
E-SoS. Systems-of-systems environment making control more difficult.	1	2	+
Risks of using agile methods			
A-Scale. Scalability and criticality of the product.	3	2	-
A-YAGNI. Use of simple design that does not scale up.	1	1	~
A-Churn. Personnel turnover with loss of expert knowledge.	3	2	-
A-Skill. Not enough people skilled in agile methods.	3	1	--
Risks of using plan-driven methods			
P-Change. Rapid change	1	2	+
P-Speed. Need for rapid results	0	1	+
P-Emerge. Emergent requirements	1	3	++
P-Plan. Unrealistic planning, high planning uncertainty.	3-4	2-3	-
P-Skill. Not enough people skilled in plan-driven methods.	2	1	-
Risk rating scale: 0: Minimal risk; 1: Moderate risk; 2: Serious but manageable risk; 3: Very serious but manageable risk; 4: Show stopper risk.			

Results Ex-Post Ratings extracted from a Workshop including PM and QM experts from academia and industry

Risk Assessment based on Boehm B., Turner R.: “Balancing Agility and Discipline – A Guide for the Perplexed”, Addison Wesley, 2004

Lessons Learned & Benefits

Lessons Learned of Applying the Hybrid Approach

- Software delivery was effective to fulfill contracts with customers and provide competitive products to the market within the planned effort and time plan.
- A systematic, goal-oriented approach for priority setting mitigates the risk of jumping between ideas and not achieving overall goals.
- Agile approaches need a strong framework for success in practice.
- Well-defined milestones can avoid losing the overall perspective on progress goals; the progress of sprint WPs has to be translated to the progress of plan-driven WPs.
- PM planning and control was effective and considerably more efficient than planned.

Benefits from Integrating Agile Sprints in plan-driven PM:

- Improvement of cost, effort, and progress controlling in all parts of the project.
- Transparent overview on needs and status of work for all project participants enabled a very effective and flexible work culture.
- An efficient and tool-supported continuous integration and test process provides visibility of progress and ensures the required software product quality
- A feature network that provides planning data enables goal-oriented negotiation of the development strategy.

Summary & Future Work

Summary

- The SME company logi.cals has systematically developed a hybrid PM approach for software research and development projects.
- Major innovations in the approach are:
  - Parallel coordinated sprints of software development, research, and marketing.
  - Integrated and very efficient overview on all WPs in the hybrid PM due to a well-integrated tool set, customized to hybrid PM needs and methods.

Future Work

- Evaluation of the hybrid PM approach in research and development groups at a variety of research organizations and SMEs.
- Support of continuous integration and test in engineering environments across organization boarders.

Thank you ...

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