Large-Scale RE, Creativity in RE

Lecture 11, DAT230, Requirements Engineering
Robert Feldt, 2010-10-12

Notes about course

- Individual assignment 3 is canceled

- Written exam: Tuesday 19th of October 14:00-18:00 in V-huset, Chalmers Johanneberg

  - No previous example exam available

  - 3 types of questions:

    - Fact (simple, based on books/articles/slides)

    - Do (performing RE tasks, based on project & applying books/articles/slides)

    - Think (extrapolate/discuss based on your knowledge, no "given" answer in material)

Recap from last lecture

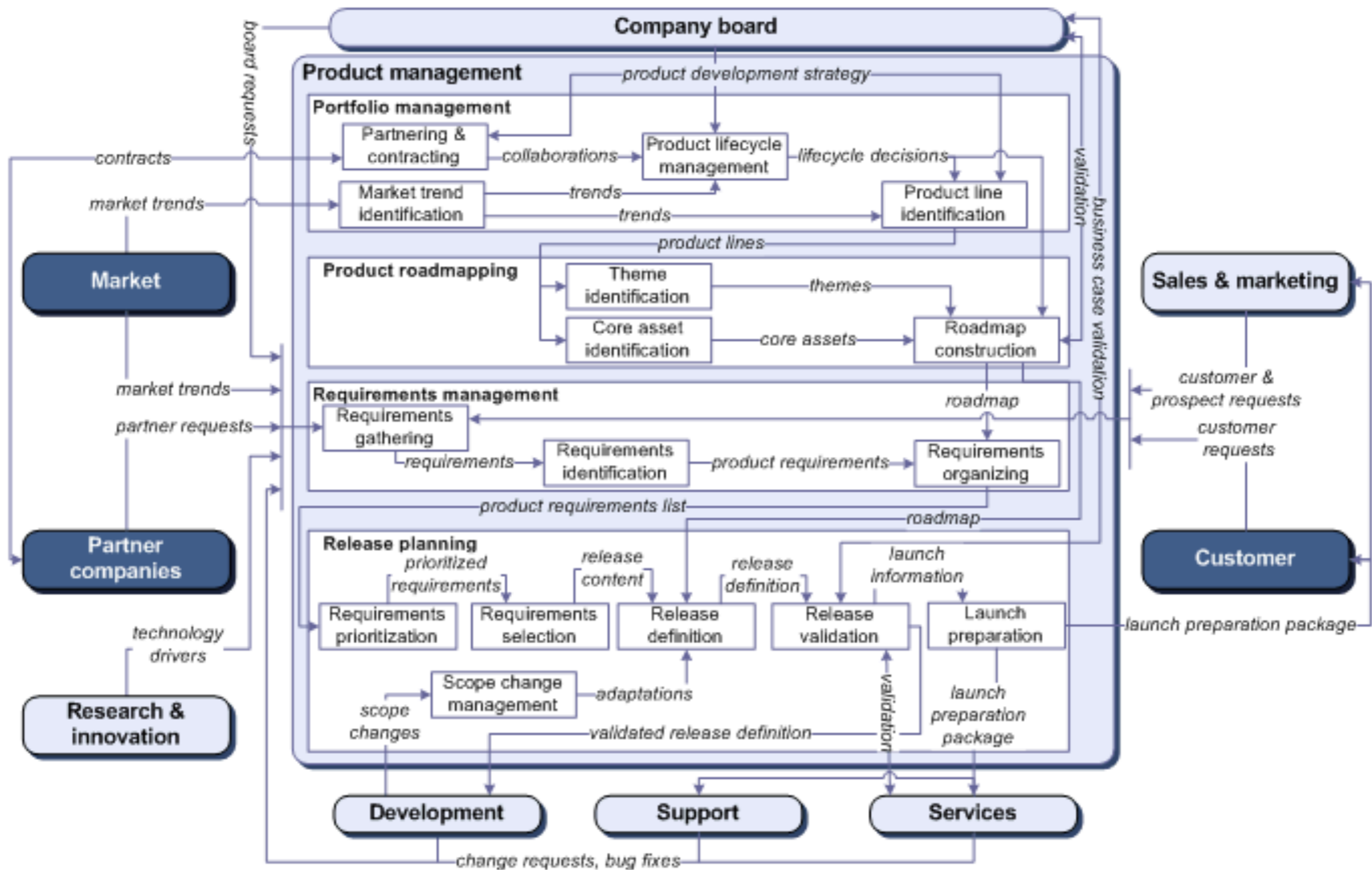# Reference framework for software product management

Table 1: Orders of magnitude in requirements engineering , based on Paper VI.

Abrev.	Level	Order of magnitude	Sample empirical evidence	Interdependency management conjectures with current RE technology
SSRE	Small-Scale Requirements Engineering	10 requirements		Managing a complete set of interdependencies requires small effort.
MSRE	Medium-Scale Requirements Engineering	100 requirements	(Feather et al. 2000)	Managing a complete set of interdependencies is feasible but requires large effort.
LSRE	Large-Scale Requirements Engineering	1000 requirements	(Park and Nang 1998)	Managing a complete set of interdependencies is practically unfeasible, but feasible among small bundles of requirements.
VLSRE	Very Large-Scale Requirements Engineering	10000 requirements	(Regnell et al. 2006)	Managing a complete set of interdependencies among small bundles of requirements is unfeasible in practice.

[Wnuk2009]

LSRE Challenges

- Large number of customer requirements

- Formal interface to customer

- Management of customer expectations

- Changing technology

- Traceability

- Scope change and creep

- Resource fluctuation

1. An initial set of 50 high level features may not appear to be a large project

50 features

2. Each high level feature is redefined to 100 or more high-level requirements

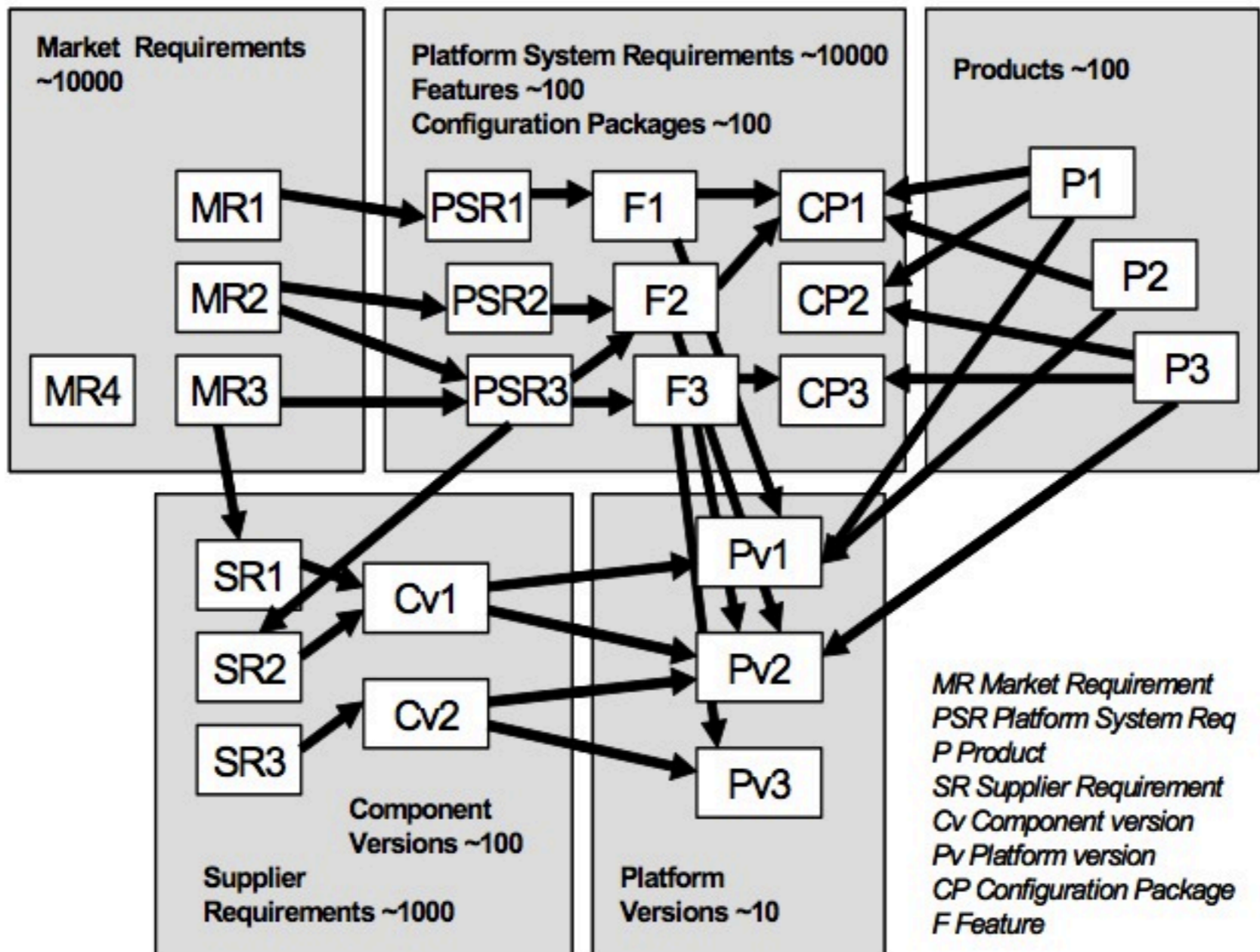3. The project can grow up to over 5000 high-level requirements

5000 high-level requirements

4. Adding an additional explosion layer of detail needed for implementation

50000 requirements + 50000 traces
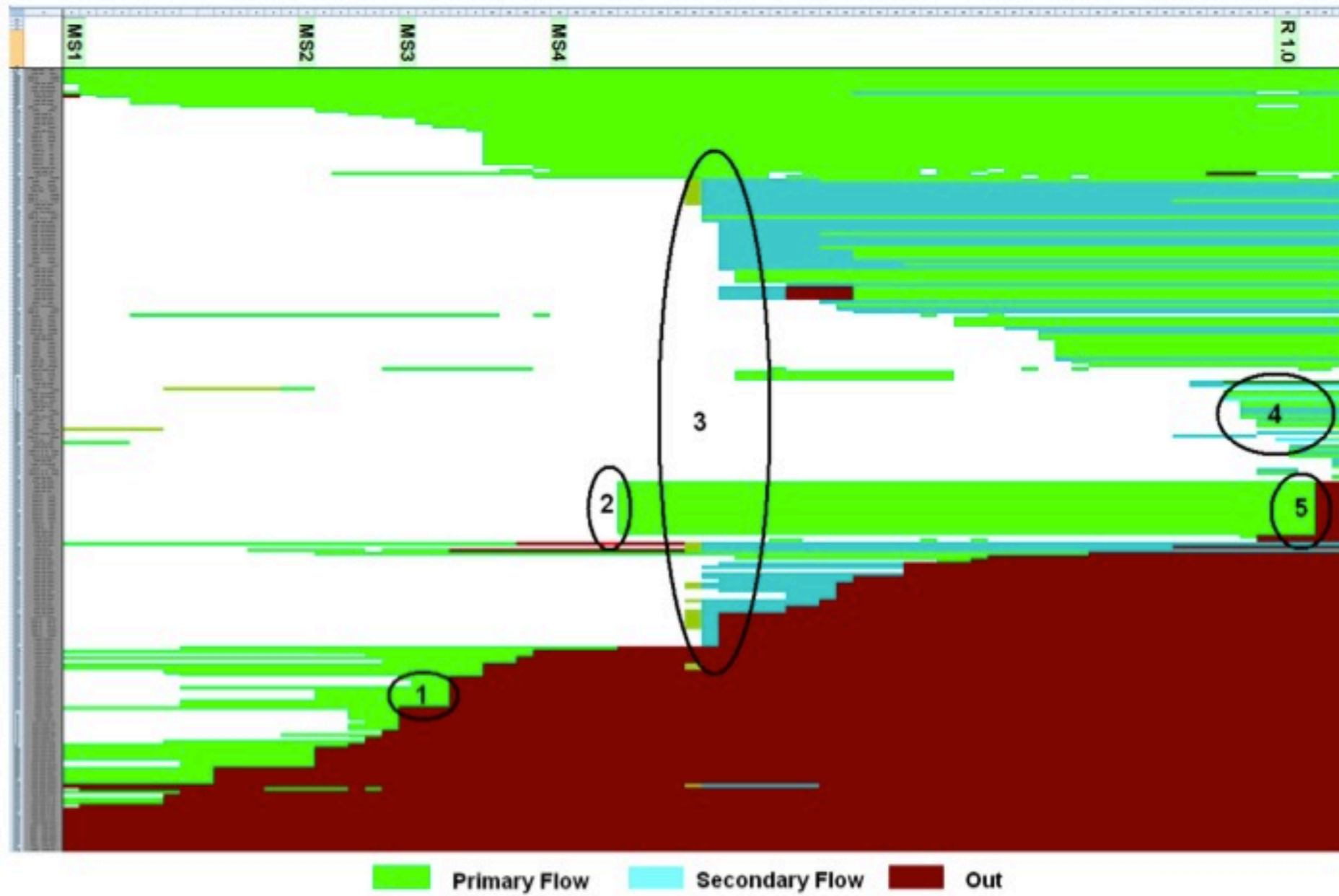
5. A total of 50000 requirements and at least the same number of traces
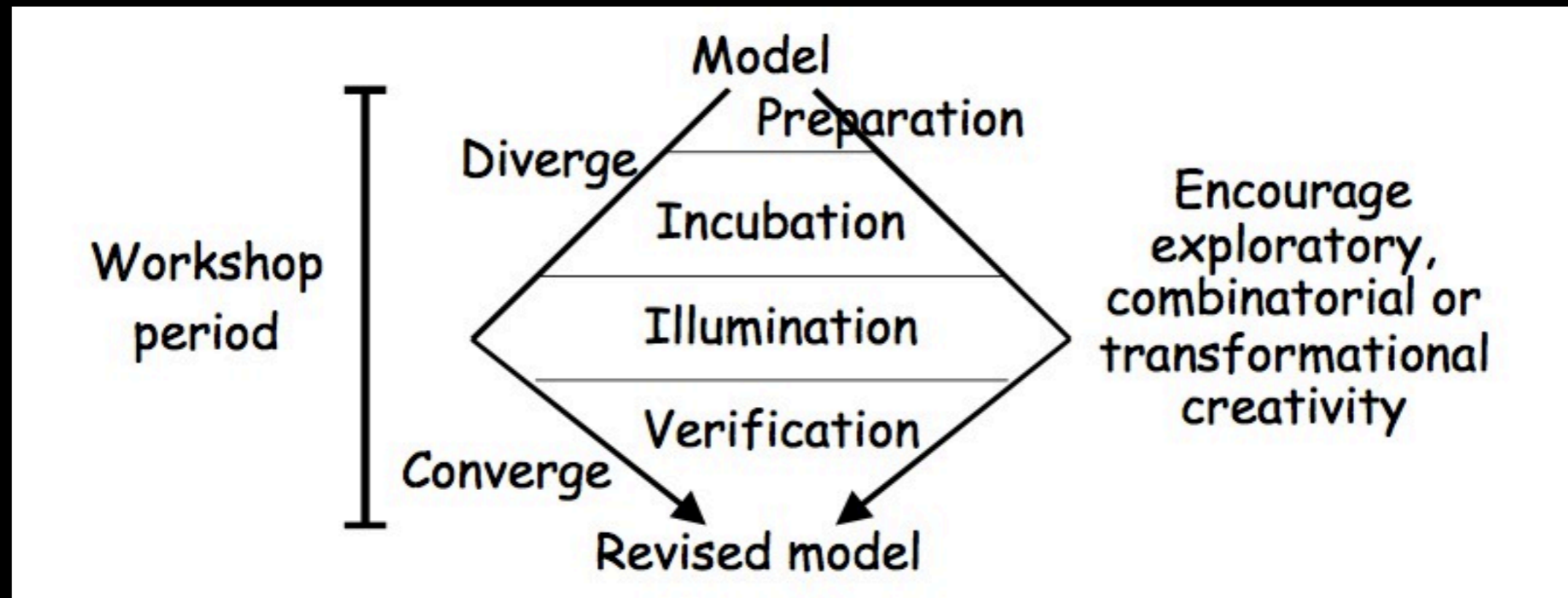
[Wnuk2009]

[Wnuk2009]

[Wnuk2009]

Creativity in RE

Creativity = ability to produce work that is both
<u>novel</u> (original, unexpected) and <u>appropriate</u>
(useful, adaptive concerning task & constraints)

[Sternberg&Lubart1995]

Creativity Workshops for RE

[Maiden2007]

Divergent & Convergent Thinking

Divergent & Convergent Thinking

Divergent thinking = generate creative ideas through exploring multiple alternatives/ possibilities

Divergent & Convergent Thinking

Divergent thinking = generate creative ideas through exploring multiple alternatives/ possibilities

Convergent thinking = select "correct" ideas among many alternatives

Divergent thinking

- Not correlated with IQ, but with:

  - nonconformity, curiosity, risk taking, persistence, musicians

- Can be promoted through:

  - creating lists of questions

  - time "off" to think and meditate

  - brainstorming

  - bubble mapping

  - keeping a journal, free writing ("stream of thought")

  - artwork

Three types of creativity

Three types of creativity

Exploratory = explore new ideas within a given conceptual space (accepts constraints/assumptions of given space)

Three types of creativity

Exploratory = explore new ideas within a given conceptual space (accepts constraints/assumptions of given space)

Transformational = deliberate transformation or transcendence of a conceptual space (rejects some constraints/assumptions of given space)

Three types of creativity

Exploratory = explore new ideas within a given conceptual space (accepts constraints/assumptions of given space)

Transformational = deliberate transformation or transcendence of a conceptual space (rejects some constraints/assumptions of given space)

Combinatorial = novel combination of existing ideas as search through space

Four steps of creativity

- Preparation - research = collect information/data

- Incubation - percolation = milling over collected info

- Illumination - light bulb = aha moment

- Verification/Implementation - creation = check realism

Maiden Case Study

- Two-day workshop to create new reqs/ideas

- Product: Air Traffic Management system

- Process:

  - 2 system engineers + domain experts: 4 months to establish high-level spec with scope and goals

  - 2-day Creativity workshop = 2 facilitators + 2 scribes + 2 external experts + 19 stakeholders

    - Focus on use case models and texts + I* models

Maiden Case Study

- 4 half-day session in 2 days

- All ~20 people in one room

- Models & text printed on 1m2 pin boards around room

  - Physical and logical structure of ideas and reqs

- Rules: No criticism during divergent periods, time-boxing different topics strictly

- Post it notes, colored pens, idea cards at hand

Maiden Case Study

Day 1 morning	Day 1 afternoon	Day 2 morning	Day 2 afternoon
Brainstorming (system wide & use case specific) Constraint identification & removal Brainstorming given removed constraints	Expert pres: Design of museum exhibitions Analogy mapping to ATM & idea creation Reporting back	Reflection Expert pres: TV program scheduling Analogy mapping & idea creation Reporting back	Created Storyboards for high-prio use cases Combining ideas Revised use cases, models & texts

Analogical mapping/reasoning

- Can help Exploratory creativity

- Steps:

  - Find similar domain (source) to target domain

  - Identify and list mappings between

    - Agents, Objects, Actions, Constraints, Goals

  - Use each mapping in turn to create new idea by transforming solution between domains

Constraint removal

- Can help Transformational creativity

- Steps:

  - Identify constraints through brainstorming

  - Divide in small groups

  - Groups consider new ideas by consecutive removal of constrinats until none remains

  - Report back and put on boards

Storyboarding

- Can help Combinational creativity

- Steps:

  - Divide in small groups

  - Groups have 1 A1 paper with 16 cartoon boxes to describe a scene of a use case

  - Report back

Case study results

Deliverable type	Number system-wide	Number use case-specific
Brainstormed ideas	16	12
EASM constraints	34	0
Ideas from EASM constraints	94	0
Ideas from analogical reasoning with museum exhibition	0	15
Ideas from analogical reasoning with TV program scheduling	0	8
Workshop1 storyboards	0	4 storyboards

Technique	Novelty			Impact		
	1	2	3	1	2	3
Brainstorming	1	10	16	11	10	7*
Science Museum Analogy	0	7	8	7	5	3
Programme Scheduling Analogy	0	2	6	2	3	3
Constraint Removal	1	21	67	8	60	21
Totals	2	40	97	28	78	34

Summary of results

- Captured both novel and unoriginal ideas

  - that were useful and affected SRS

  - 106 of 140 ideas was useful

  - 42 of 139 ideas was novel

- More effect on abstract goals and concepts than actual reqs

- Constraint removal effective but needs more structure

- Sometimes hard to record all ideas ("idea blizzards")

- Analogy techniques not very cost-effective