

# Technology Trend Roadmap for Modelling & Simulation

Dr. Martin Rother ITEC 2018



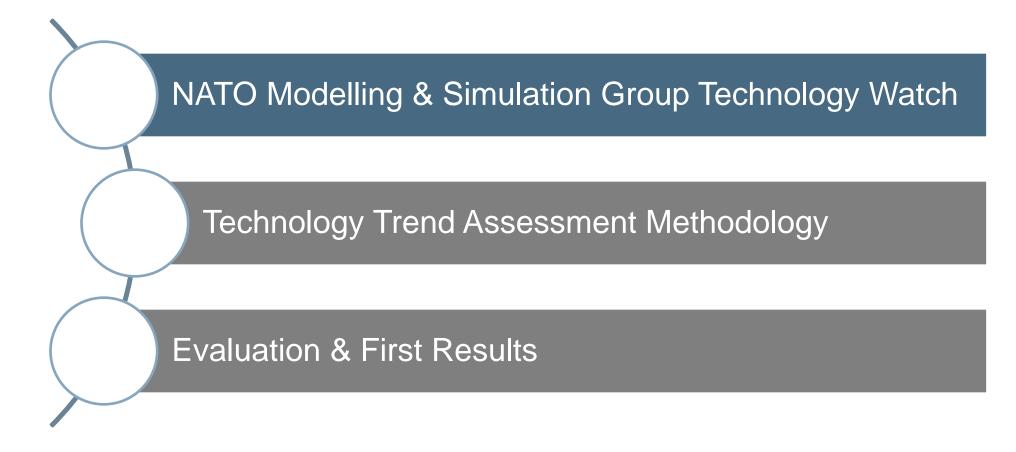






### Agenda









### NATO Modelling & Simulation Group Technology Watch



- NATO Science & Technology Organization (STO) continuously performs Technology Watch
- Led and reported annually by the NATO Chief Scientist
- Contributions from STO Panels and Task Groups within STO
  - i.e. bottom-up
- Influence on STO Panels and Task Groups Program of Work (PoW)
  - i.e. top-down







### NATO Modelling & Simulation Group Technology Watch



#### NATO Modelling & Simulation Groups (NMSG) needs to address emerging Tech Trends

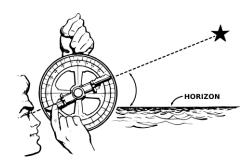
- possible actions
- priorities
- roadmap

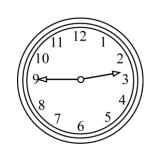
#### Need for a methodology / toolset

- assessment (where are we now)
- gap identification (where should we go)

#### **■ Team effort under NMSG supervision**

- W. Huiskamp
- F. Perez-Duenas
- R. Siegfried
- W. Bennett
- M. Rother











### NATO Modelling & Simulation Group Technology Watch



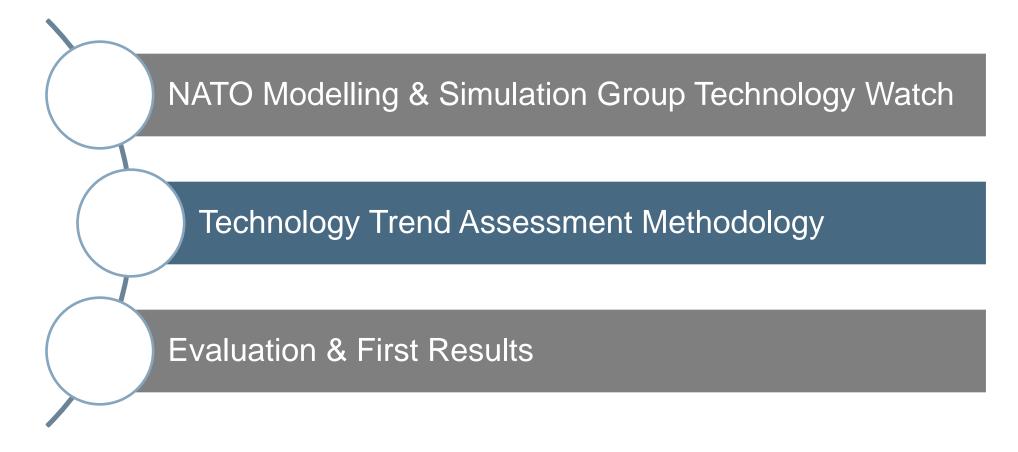
- How to assess the impact of technology trends on M&S ?
  - ask the experts !!!
- General open questions lead to general open answers
  - "Will trend XYZ influence M&S?" — "Yes"
  - "Which trend is most important?" — "Trend XYZ, my field of work"
- Need for a more structured approach
  - be more specific
  - categorize assessments
- How to identify gaps and required actions?
  - direct consequence of proper assessment





### Agenda



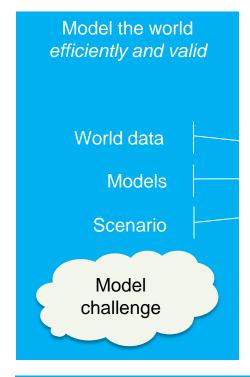


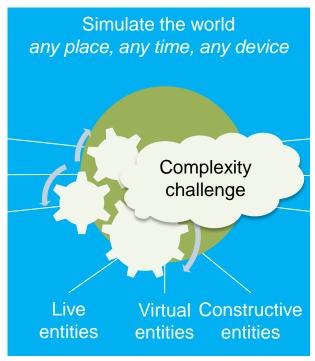




### **Technology Trend Assessment Methodology The M&S Workflow**









Simulation workflow modelling and simulation done effectively and efficiently

Time is of the essence

reference: Wim Huiskamp





### Technology Trend Assessment Methodology The M&S Workflow



Model the world efficiently and valid

Simulate the world any place, any time, any device

Transform results actionable knowledge

World data

Data

Where is the technology?
Where will a Tech Trend have an impact?
Why will a trend be relevant for M&S?

Simulation workflow modelling and simulation done effectively and efficiently

Time is of the essence

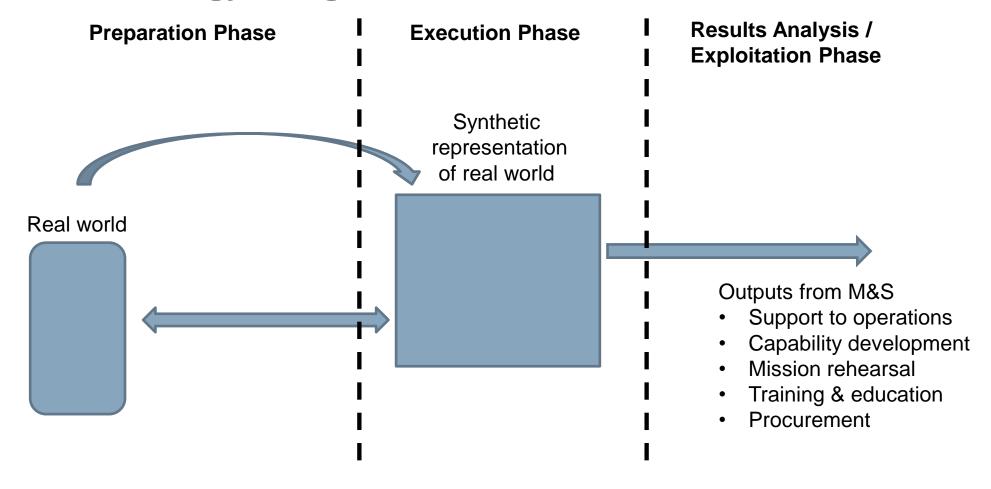
reference: Wim Huiskamp





### Technology Trend Assessment Methodology Technology Categories in M&S



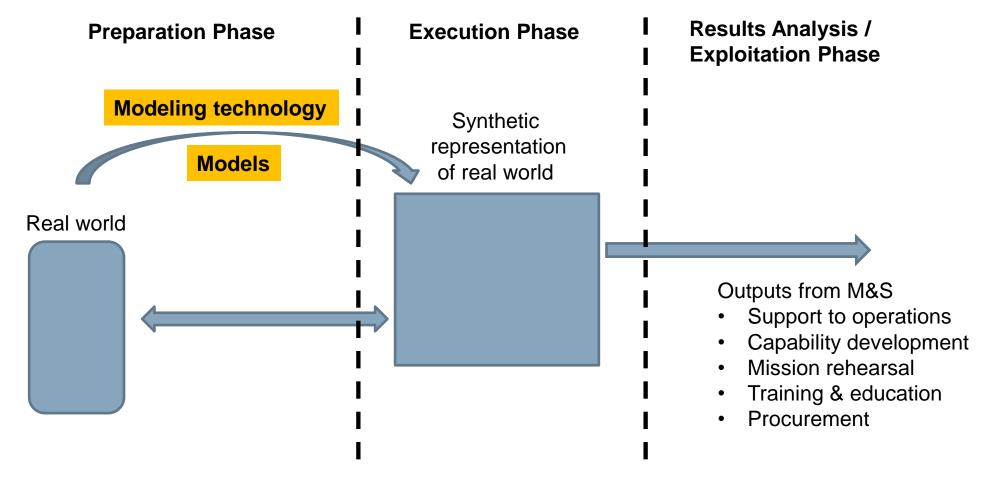






### **Technology Trend Assessment Methodology Technology Categories in M&S**



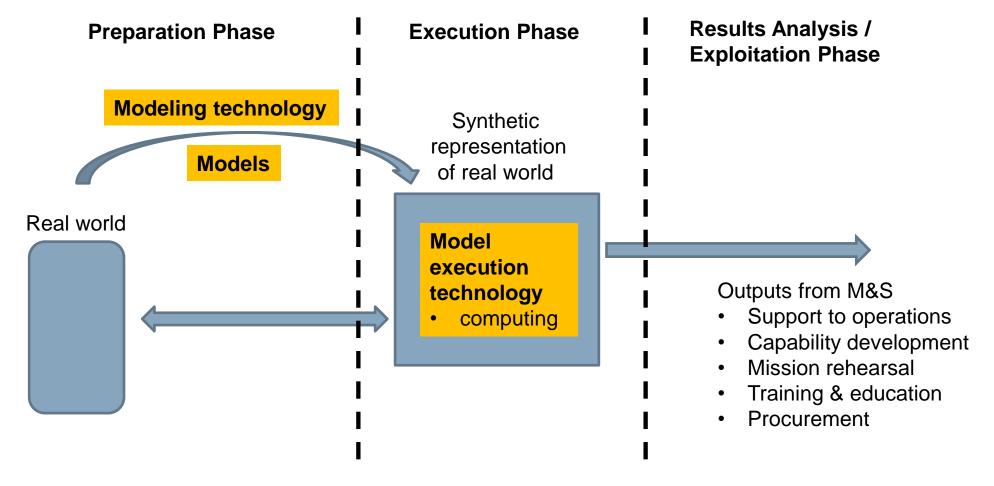






### **Technology Trend Assessment Methodology Technology Categories in M&S**



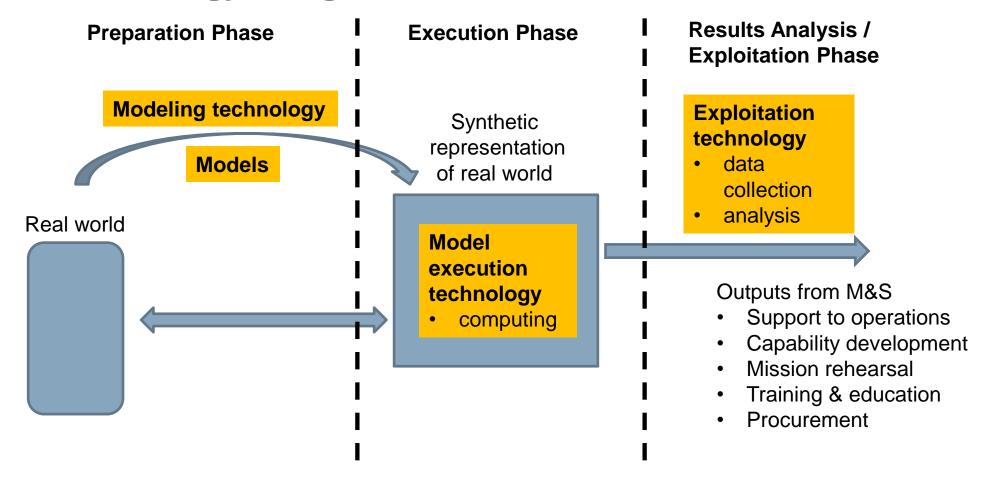






## **Technology Trend Assessment Methodology Technology Categories in M&S**



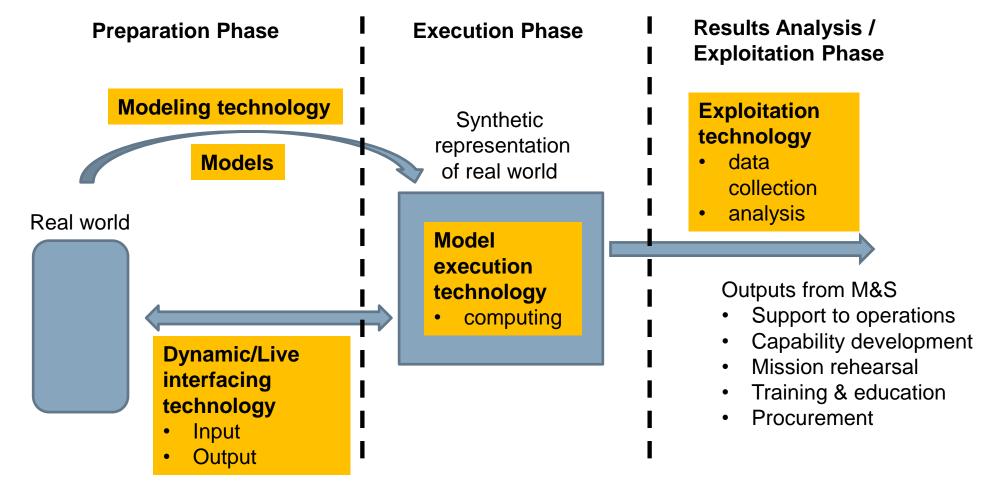






### Technology Trend Assessment Methodology Technology Categories in M&S



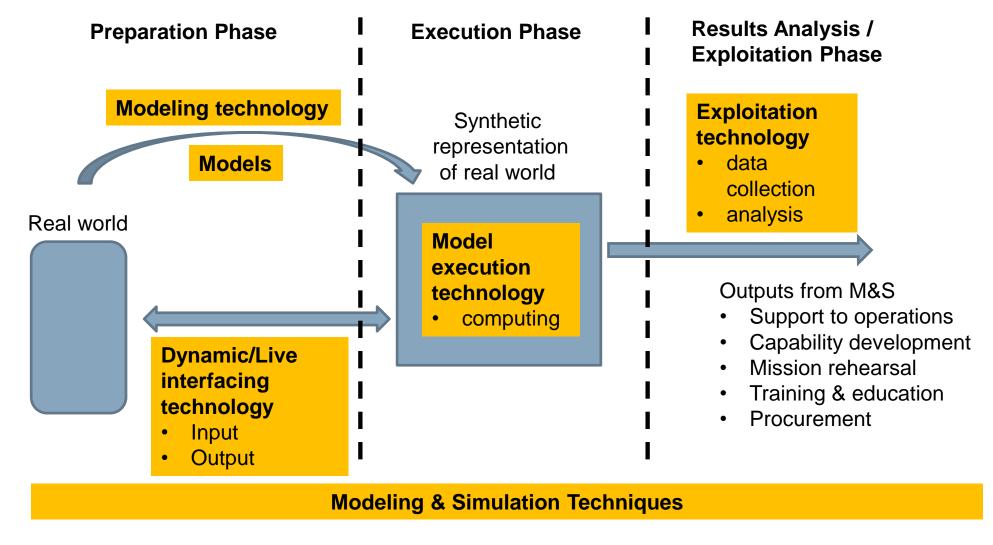






### Technology Trend Assessment Methodology Technology Categories in M&S









# **Technology Trend Assessment Methodology Examples**



M&S Technology Application Area	Current situation	Candidate Future Technology
Dynamic Interfacing	Image generators, Joysticks	AR/VR glasses, Motion tracking
Modeling	SME's expertise	Machine learning
Models	Specialized SW/HW	Virtual prototyping, Additive manufacturing
Model Execution	Individual PCs, HLA/DIS	Clouds, Ubiquitous computing
Exploitation	Reports, Databases	Big data analytics
M&S Techniques	DSEEP	DSEEP overlays, Pay-per-Use





### **Technology Trend Assessment Methodology Assessment Categories**



#### Category 1

- technology already in use
- research activities in progress
- first results and demonstrations available

#### Category 2

- possible impact on M&S
- not immediately, but in the long term
- assessment unsure
- more research needed

#### Category 3

- already strong impact in non-M&S domains
- no known research activities in the M&S domain
- possible gap in PoW

#### Category 4

most likely no strong impact on M&S











# **Technology Trend Assessment Methodology Assessment Example**



Tech Trend	Modelling	Models	Interfacing	Execution	Exploitation	Techniques
Mixed Reality						
Sensors are Everywhere						
Artificial Intelligence						
Unmanned Air Vehicles						
Social Media						
Everywhere Computing						





### Technology Trend Assessment Methodology by M&S Application Area



#### Impact may depend on M&S use case

- e.g. "Unmanned Systems"
- are/will be used to support operations, expected more application in training
- probably less useful for M&S application in procurement

### M&S application areas according to the NATO Modelling & Simulation Masterplan (NMSMP)

- support to operations
- capability development
- mission rehearsal
- training & education
- procurement





### **Technology Trend Assessment Methodology Tech Trend Assessment Table**



#### ■ Technology Trend sources

- STO Tech Trend Report
- NMSG members, nations
- STO Trend Workshops
- SMEs from NATO nations
- civil sources (e.g. Tech Trend Reports from consulting companies, ...)

#### Assessment sources

SMEs from NATO nations

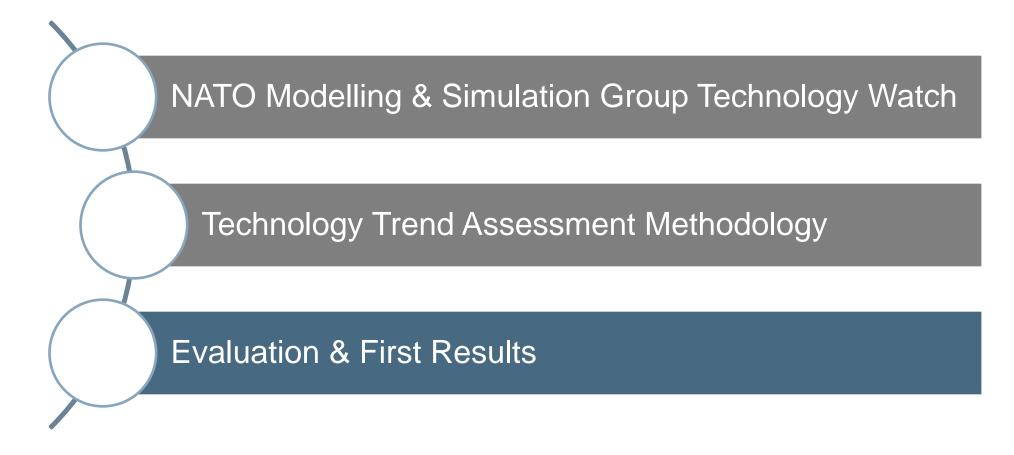
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### **Agenda**









# **Evaluation & First Results First experiences using this approach**



#### Challenges / Feedback / Lessons Learned

- many table cells  $(19 \times 5 \times 6 = 570)$
- SMEs feedback not homogeneous
  - some textual, some coarse to some fine grained color coding
- Technology Usage Areas not always clearly distinguished
  - e. g. modelling vs. models
- biased by SMEs activity area and education
- top-left cells tend to receive more input/attraction than bottom-right cells
- currently poor basis for statistical evaluation
- Strict cell-by-cell evaluation currently not suitable
- Instead try to derive "hot spots"
  - use "heat map"-like approach to indicate SMEs interest





### **Evaluation & First Results Tech Trend Heat Map**



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- Known research activities
  - already part of NMSG or STO PoW
- Uncertainty, Candidates
  - more research needed to assess potential or impact
- Gaps
  - considered highly important
  - more research needed
- Not relevant for M&S

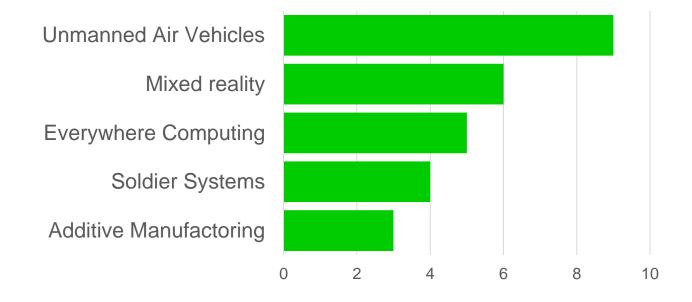




# **Evaluation & First Results Towards a Tech Trend Roadmap for M&S**



#### **Top 5 Tech Trends with ongoing research & evaluation activities**



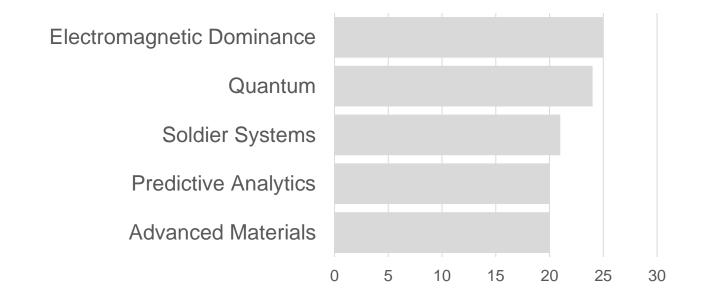




# **Evaluation & First Results Towards a Tech Trend Roadmap for M&S**



#### Top 5 Tech Trends assumed to have least impact on M&S



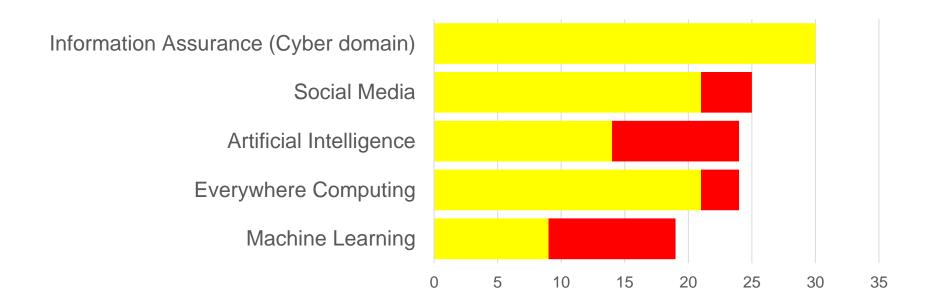




# **Evaluation & First Results Towards a Tech Trend Roadmap for M&S**



#### Top 5 Tech Trends with most need for research & evaluation



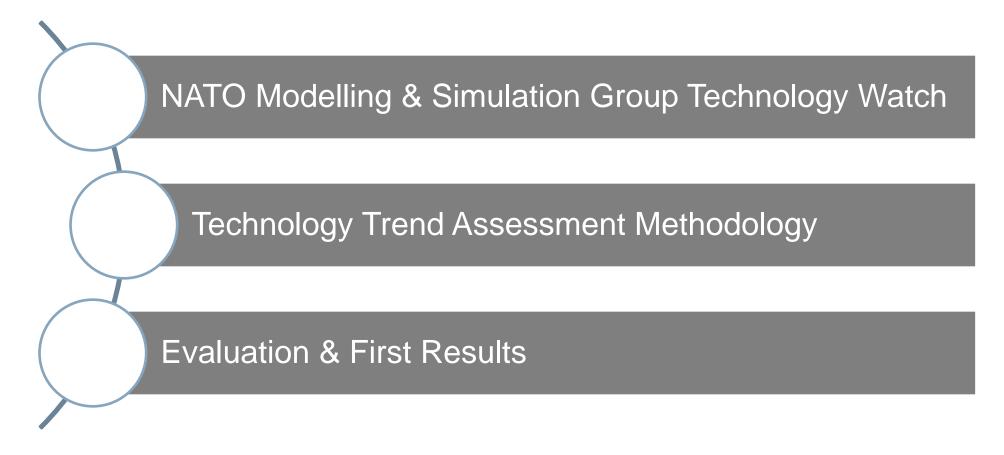
**CAVEAT** poor statistics





### **Summary**









# Thank you for your attention!

### Senior Technical Manager Modelling & Simulation

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