Transactional Intent

SYSTEMATIC THOUGHT LEADERSHIP FOR INNOVATIVE BUSINESS

Shel Finkelstein, Thomas Heinzel, Rainer Brendle, Ike Nassi, Heinz Roggenkemper
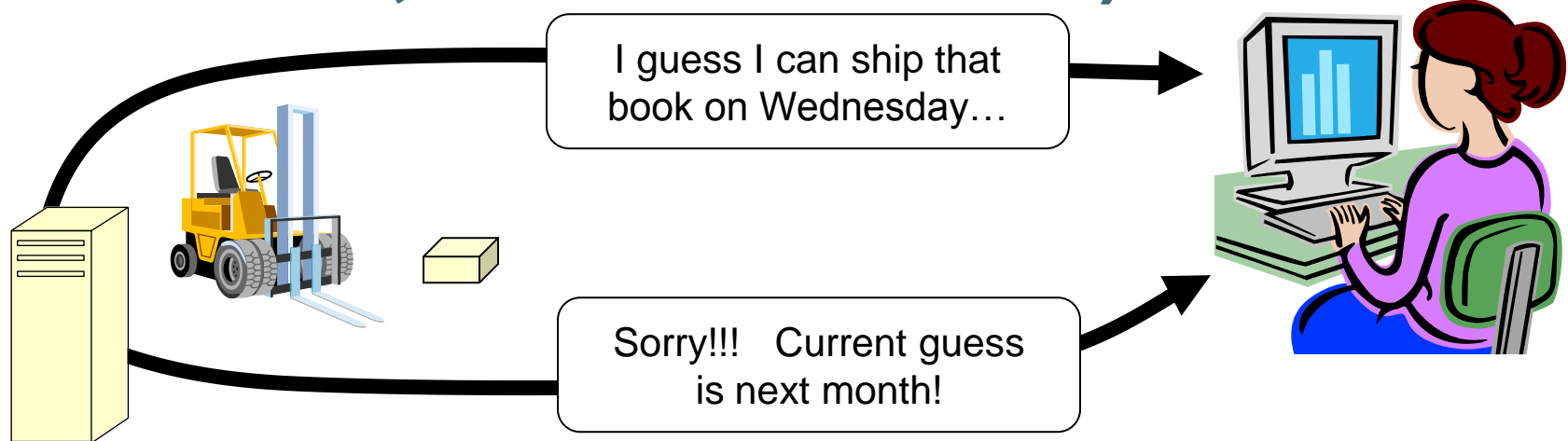
SAP Labs

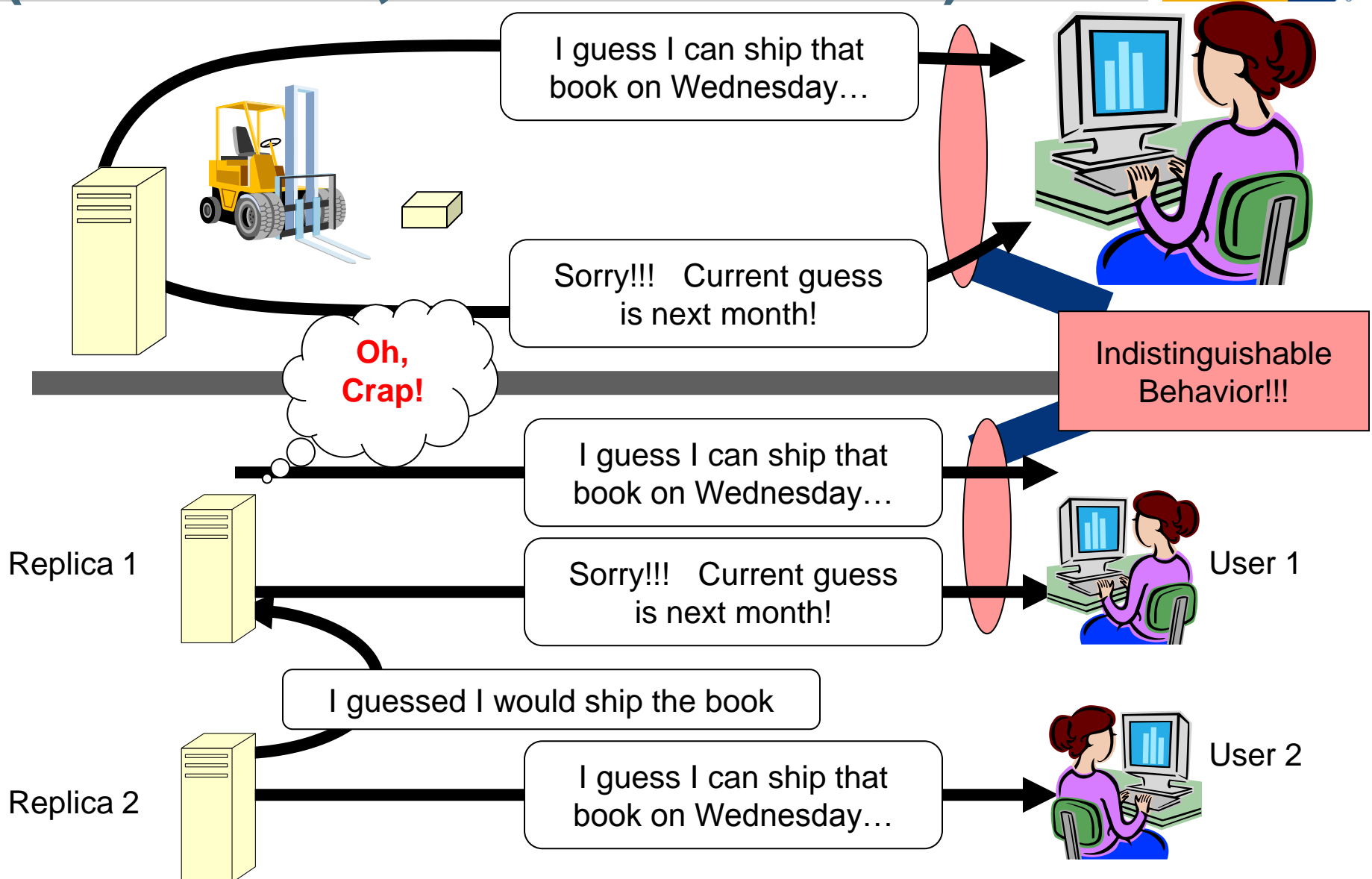{firstname.lastname}@sap.com

Outline

- Motivation

- Example applications

- Framework for intent

- Additional aspects of intent

- Conclusion

Motivation

- Value-oriented database

  - Transaction replaces old DB state for business objects (balance 30) with new DB state (balance 50)

  - Problem: Works only if DB state is as expected

- Operation-oriented database

  - Describe transaction as a set of operations that can be performed in any state (add 20 to my balance)

  - Problem: Binding operations to transaction depends on state

- Intent-oriented database

  - Capture transactional intent which can be interpreted for execution in any state

  - Generalizes Pat Helland's apology-oriented computing, with examples and framework

Apology-Oriented Computing (Pat Helland, CIDR and TechEd)

Apology-Oriented Computing (Pat Helland, CIDR and TechEd)

Outline

- Motivation
- Example applications
- Framework for intent
- Additional aspects of intent
- Conclusion

Order Entry

- Order some books (for example)

- Initial message acknowledges your order

- Next message tells you if/when your books are scheduled to be delivered
    - Separation of order ack from fulfillment message is significant

- Subsequent messages may tell you that deliveries are accelerated or delayed, or that some books are unavailable
    - You may cancel delivery if delay is unacceptable

Calendar

- While disconnected, you schedule a meeting to occur
  - After Monday Project Meeting, by Friday
  - With manager and at least 2 co-workers
- Meeting is scheduled for Tuesday a.m.
- When you connect, meeting is moved to Wednesday, because Project Meeting is now Tuesday p.m.
- Changed to Thursday because manager had higher priority meeting
  - Change bumps lower priority meeting for co-worker

| M	T	W	T	F	S	S
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Supply Chain Production Scheduling
Do you need a tool to ...

… create a production schedule considering all capacity constraints and material availability?

…actively support you in creating backlog free production plans considering priorities?

… support you in personalized exception based planning considering all orders?
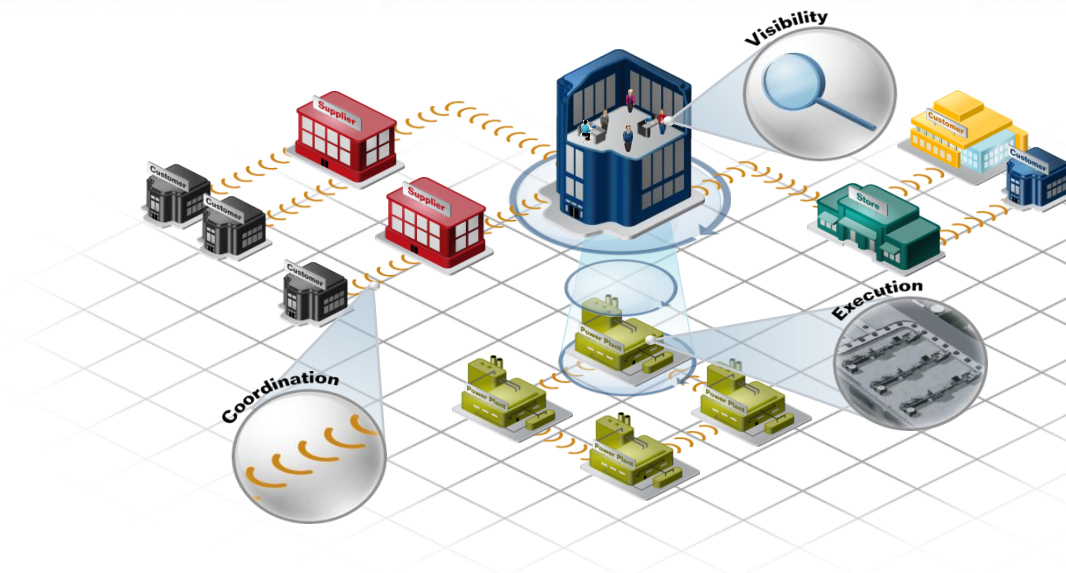
… support you in creating optimized production plans in all your factories?

… show the critical path, missing parts and the cause of the delay?

… allow what-if scenarios and simulation for planning alternatives and the con-sequences for the sales orders ?

# Supply Chain Production Scheduling (SAP Advanced Planner and Optimizer)

- Supplier receives purchase order from customer

- Supplier determines constraints (quality, deadline) and objective function (weighted sum of profit, time, priority)

  - Long-term and short-term considerations

- Supplier wants to schedule production jobs to maximize objective function (including penalties for late delivery)

  - Materials depend on other materials

  - Initially schedule job subject to existing schedule

    - May bump lower priority jobs

  - Periodically, globally schedule jobs to optimize schedule

  - Events for job cancellation, production line problems, dependency delays/accelerations, overrides, etc.

Production Scheduling Planning Board

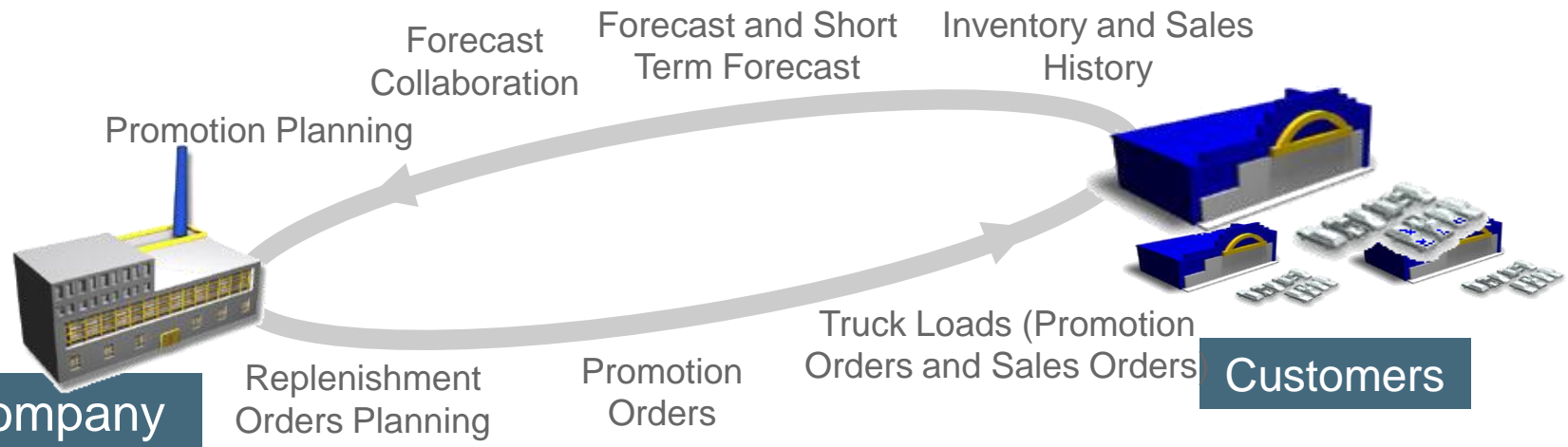**Detailed Scheduling Planning Board, Planning Version 000**
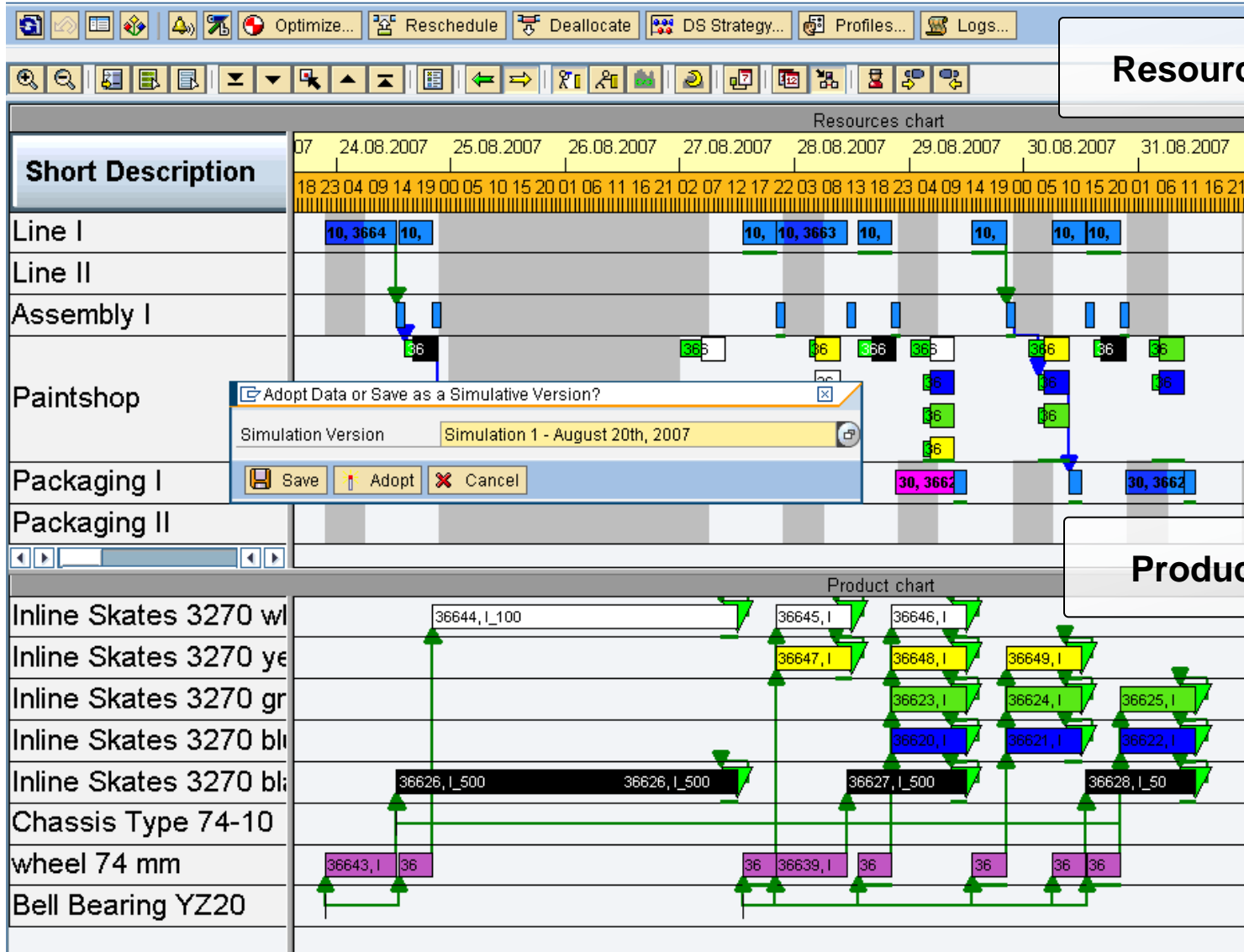
Resource View

Product View

Supply Chain Business Interactions (Availability-to-Purchase)

- Purchaser issues request to supplier(s) asking for terms for items, specifying quantities, delivery dates, quality, etc.

- Supplier responds with *term sheet*, including deadlines

- Purchaser may submit *purchase order* based on term sheet

- Supplier may prepare internal *sales order* and schedule delivery if purchase order is accepted

- *Process intent* supports interactions, including:
  - Supplier tentatively reserving quantities for prospective purchaser
  - Optimization by supplier across all sales orders
  - Supplier apology if term sheet can't be honored or delivery is delayed
  - Purchaser action if supplier reneges
  - Internal, externalized, predictive intent between purchaser and supplier

Supply Network Collaboration

Forecast Collaboration

Forecast and Short Term Forecast

Inventory and Sales History

Promotion Planning

Truck Loads (Promotion Orders and Sales Orders)

Customers

My Company

Replenishment Orders Planning

Promotion Orders

- **Responsive Replenishment ...**
    - Is a real-time, demand-driven replenishment scenario between supplier and customer, including up and down shifts of orders and shipments in the short term--next generation Vendor-Managed Inventory (VMI)
   - Manages promotional items separately through-out end-to-end replenishment process and optimizes truck loads
- **Min/Max Replenishment ...**
    - Supports traditional VMI replenishment scenarios using min and max stock limits
- **Demand Collaboration ...**
    - Offers a time-bucketed, on-screen, collaboration and workflow driven capability to reach a consensus forecast between customers and suppliers

Operational Business Intelligence
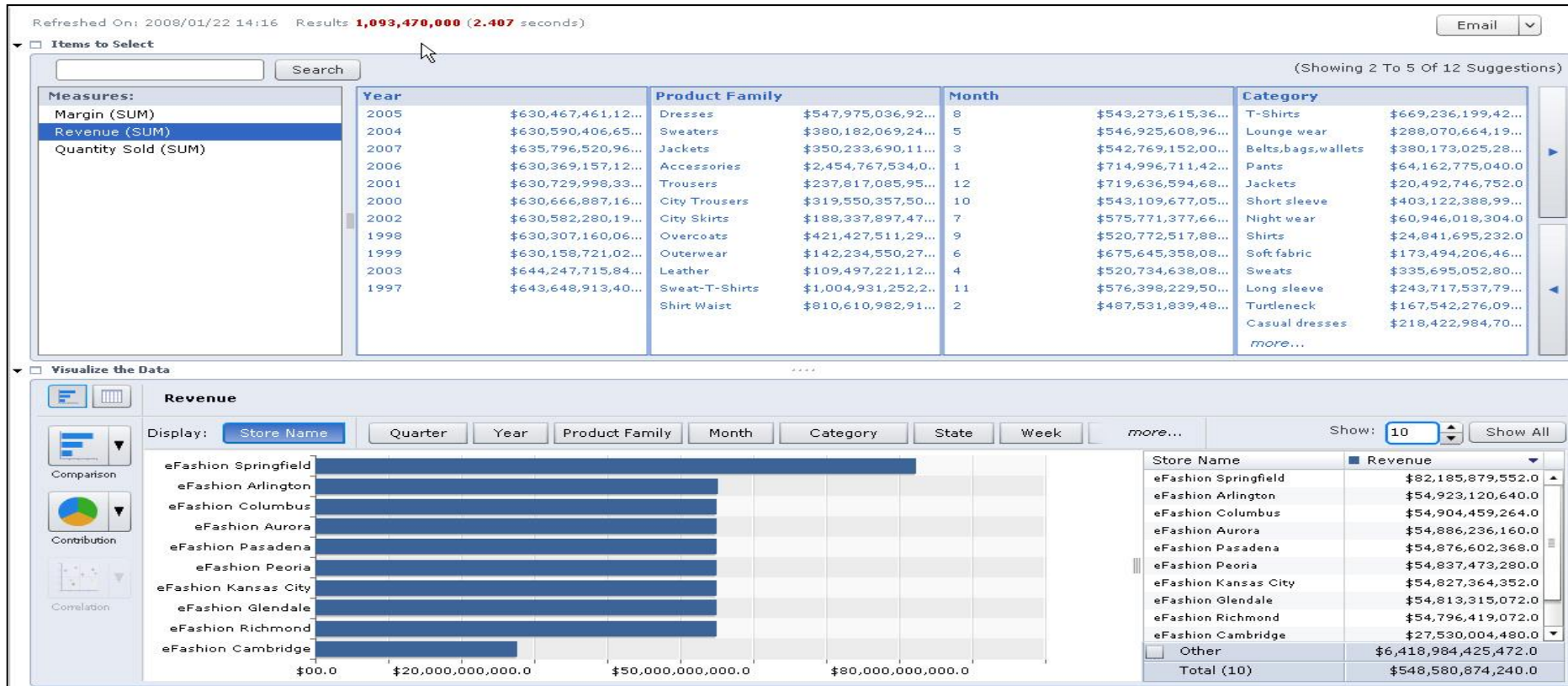
- Knowledge worker makes a decision looking at current state
  - But state change may make decision inappropriate
- Decisions expressed as intents can be applicable in any state

Outline

- Motivation

- Example applications

- Framework for intent

- Additional aspects of intent

- Conclusion

Framework for Intent

- Intent expression
- Intent optimization engine
- Satisfaction events/callbacks
- Change metadata

Intent Expression

- Expression includes:
  - Goal
  - Constraints
  - Optimization parameters (e.g., priorities, costs, heuristic business parameters)

- Examples: book order, calendar appointment, production job
- Expressed in a domain-specific language
  - May be imperative (code) or declarative goal (as in calendar example)

Intent Optimization Engine

- Determine which intents will be satisfied and how they will be satisfied, using priorities, ordering heuristics, or an objective function, such as maximizing profits
  - Objective function can use optimization parameters, such as revenue and cost
  - Unsatisfied intents may generate objective function penalties
- For example, Operations Research techniques may be used for optimization of supply networks
- Optimizer produces Execution Plan for each Intent that's satisfied
- Meta-Intent may control optimization

Satisfaction Events/Callbacks

- **Application framework includes events or callbacks for each intent**
  - Satisfaction events for initial execution plan or a new execution plan
  - Non-satisfaction events
- **For example, people invited to a meeting should request meeting requests when the meeting is scheduled, cancelled or rescheduled**
  - … and the submitter should be notified if the meeting cannot be scheduled
  - When a scheduled meeting has to be cancelled because of a higher priority meeting, that's an apology, which may be handled by the system or alert the user

Change Metadata

- Change metadata is needed for compensation (which is forward-going, not an undo), as well as for re-planning

- Intents
  - Store intent in the DB so it can be referenced and used

- Dependency data
  - Examples
    - Sales Order depends on one or more Production Orders, which may depend on other Production Orders (for subparts)
    - Production Orders also depend on the Sales Order
  - Creation, maintenance and use of dependencies is complex

- Version history
  - Not just state versions, but the intents which generated those changes

Outline

- Motivation

- Example applications

- Framework for intent

- Additional aspects of intent

- Conclusion

Additional Aspects of Intent

- ## Process intent
    - Decomposition of process intent into sub-processes/transactions
- ## Auditing, mining and predictive analytics
- ## Compensation and change
    - Combining forward-going compensation with new plan
- ## Meta-intent
    - Product manufacturer, software company, cloud provider/admins
- ## Eventual consistency and replication
- ## Cooperating businesses and applications
- ## Performance and usability
    - How is intent captured? How abstract is intent semantics? How much can old plans be perturbed? How are plans visualized and explained?

Conclusion

- Data management and app frameworks are inseparable
  - Including behavior with data led to object-oriented programming
  - Things change, and that leads to intent-based data mgmt framework
    - Handling apologies and other satisfaction/non-satisfaction events
    - Apps affect each other; interactions must be managed/maintained

- Intent is valuable for a wide range of applications
  - Examples involve scheduling, planning and collaboration, and that's a lot of applications
  - But intent seems useful for any apps where things change and the changes have consequences … and that's nearly universal

- Additional systems research and experimentation would be valuable
  - Great topic for pragmatic study, prototyping and analysis

Transactional Intent

Shel Finkelstein, Thomas Heinzel, Rainer Brendle,
Ike Nassi, Heinz Roggenkemper

SAP Labs

{firstname.lastname}@sap.com