Review of FOCAPO 2003

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Outline

- Assess if FOCAPO goals achieved
- Recap main new or reaffirmed themes
- Identify promising innovations
- Suggest what is missing
- Bid adieu

FOCAPO 2003 Goals

- Expand view of operations beyond single plant:
  - » the enterprise perspective
- Expand scope of supply chain management (SCM):
  - » R&D & product pipeline
- Strengthen industrial participation

Assessment of Goal 3
Industrial Participation

- Industrial invited speakers: 50%
- Industrial/collaborative contributions: 50%
- Industrial attendees: 35%
- Financial support: ExxonMobil, Eastman,DuPont, Bayer, Mitsubishi Chemical, ILOG

Conclusion: Goal 3 achieved

Assessment of Goal 1
Expand view of operations

- Shapiro: Holistic & integrated view of SCM, including supply/purchasing, demand management, capital planning,
- Houston (oil): managing molecules from well-head to fuel pump
  - » SCM support for timely human decisions
- Thijssen et al (oil & petrochemicals)
  - » Horizontal integration: crude trading through product trading
  - » Convergence of strategy, planning, scheduling & on-line optimization
- Tolle et at (chemicals): Collaborative planning between multiple sites
- Pinto et al (refining): MINLP planning of refinery complex: crude supply, multiple refineries and inter-refinery supply pipelines
- Turkay et al: Industrial zone energy supply system integration
- Several applications: refining, petrochem, pharma, fruit processing,etc

Conclusion: Goal 1 well achieved

Assessment of Goal 2
Expand scope of SCM

- Shapiro: SCM in context of strategic planning
- Shah: pharma sector opportunities
  - » Simultaneous product selection & capacity planning
  - » Simultaneous product development & plant design
  - » Keeler: affirms simultaneous approach in biopharma sector
- PSE opportunities to support drug discovery
  - » Gardner et al: informatics to support high throughput discovery/development of active forms & formulations
  - » Maranas et al: optimization & modeling opportunities
    - – Protein engineering, Analysis of metabolic pathways, Identification of regulatory networks
  - » Not directly linked to SCM

Conclusion: Goal 2 achieved

What new has been learned?
Categories of contributed papers

- Incremental extensions of previously reported developments (25%)
  - » Useful but increment must be substantive (minimum publishable unit?)
- Progress reports on continuing major projects (15%)
  - » Needed but real progress must be shown (project advertisement?)
- Preliminary reports on new approaches (15%)
  - » Informative but must be more than just preview (vapor ware?)
- Application of existing methods & tools (30-35%)
  - » Important to demonstrate power of current methods & tools
  - » Application should stretch methodology (stretching student not enough!)
- Novel concepts & ideas: well-developed & tested (10-15%)
  - » Most valuable category but usually in short supply

Good job by chairs & reviewers!

Key new /reaffirmed themes

- Central role of dynamics in SCM

  (speed: marketplace drivers)

  - » Intentional exploitation of dynamics vs suppression
  - » Dynamic RTO & control (Marquardt et al)
  - » Reactive scheduling strategies (MPC analogs)
- Importance of incorporating uncertainty & risk measures
  - » Scenario planning & stochastic optimization (Sahinidis, Shapiro)
  - » Hedging/Real options to mitigate risk (Rodgers et al; Blau et al)
- Importance of SCM in context of business strategy

  (e.g, financial planning, revenue maximization)
- Continued push towards vertical integration of functions

Methodology Take-away messages

- Re-emergence of large scale, discrete event Monte Carlo simulation models, incorporating:
  - » business process models (Shah)
  - » linkage to control/optimization module (Cheng & Duran)
- Progress in optimization of hybrid models (Barton&Lee)
  - » Convex relaxation of nonconvex models (details left to reader)
  - » Problem scale still limited (tech push or market pull?)
- Growing recognition of role of constraint programming (Lustig, Jernstrom & Westerlund, Zebalos & Henning)
- Important classes of stochastic programs require global optimization methods (Sahinidis)

  (e.g.,Stochastic integer programs, Probabilistic programs)

Interesting Innovations

- Successive adaptive model refinement in RTO (I1:Briesen/Marquardt)
- Approach to nonlinear chance constraints (T10:Arellano-Garcia et al)
- Scenario aggregation (P7:Gatica et al)
- Scheduling & planning with recipes involving conditional tasks (T12:Choi et al)
- Model-based sensor network design/retrofit with cost, fault diagnosis, & reconciliation drivers (Bagajewicz, I4:Bhushan et al)

Interesting Innovations

- A priori assessment of benefits of planning & scheduling (P20:Roeterink et al)
- Improvements in MSPC approach to fault detection via Independent Component Analysis (C2:Kano et al)
- Probabilistic fault diagnosis using OO implementation of Bayesian networks with adaptive capabilities (IS11:Weidl et al)
- Heuristic approach to control of HEN (C12:Whestphalen et al)

Issues requiring further attention FOCAPO 2008?

- Education/curriculum issues
  - » Exposure of engineers to process operations issues & tools
  - » Training of power users of SCM tools
  - » Preparation of next generation of developers
- Algorithm development /engineering
  - » Opt studies generally used decomposition strategies
  - » Sub-problems solved using commercial packages
  - » Is there benefit in specializing solver to exploit structure?
- Rigorous approaches to vertical integration of SCM decision support levels and tools
  - » Ad hoc approaches predominate

Issues requiring further attention FOCAPO 2008?

- Intelligent supervisory control system
  - » Integration of scheduling/RTO, fault diagnosis, control
  - » On-line fault diagnosis & off-line process hazards analysis (Venkatasubramanian)
- Tools to facilitate SCM modeling, model update, maintenance & result interpretation/explanation
  - » Studies used std model languages, solvers & I/O interfaces
  - » Model building & updating requires high expertise (Preissig)
  - » Understandable results critical to acceptance (Houston, Tayur)
  - » Results sharing, evaluation, decision making require support tools (Heijen-Verwater-Lukszo, Joshi et al)

Issues requiring further attention FOCAPO 2008?

- Framework for handling networks of distributed & cooperative but independent entities in SCM
  - » Web-based systems to share decisions & facilitate manual adjustments (Tolle et al)
  - » Treatment of outsourcing of secondary manufacturing, alliances, joint venture decisions (Shah)
  - » Decentralized control perspective on SCM (Ydstie et al)
- Competitive gaming with SCM tools
  - » (e.g, Product introduction strategies, pricing strategies, alliances, M&A)
  - » Web-based trading chain management (Birewar)

Conclusion

- Strategic business context raises level of impact of SCM developments & provides added driver for R&D
- Research & application opportunities exist in decision support for extended supply chain
  - » Financial planning
  - » Discovery & development processes
- Collaboration between operating companies, academia & vendors is critical for innovation & rapid realization of benefits

Conclusion

- Process Operations is alive & well
- Cheers for Ignacio & Conor!

FOCAPO 2003: A great success!

- On to FOCAPO 2008!