When to use decentralized stocks and lateral transshipments in spare parts networks for high-tech equipment

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• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

ISIR NEWSLETTER

November 2006 Vol. 24. No.2.

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Sven Axsäter (Sweden)	1996-1998
Maurice C. Bonney (UK)	1998-2000
D. Clay Whybark (USA)	2000-2002
Moheb A.Ghali (USA)	2002-2004

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Management: **Alan J. Stenger**, Pennsylvania State University, USA
Modelling: **Stefan Minner**, University of Mannheim, D

DEPUTY SECRETARY GENERAL:
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Erik van der Sluis, University of Amsterdam, NL
Gyula Vastag, CEU, H

CONTENTS

EDITORIAL

This issue gives an account of the events and programs of the 2006 ISIR Symposium. This was the 14th Symposium, biannually held since 1980, and certainly one of the most interesting ones ever since. It has proven that even though inventory research is in the corner (instead of the center) of several well established scholarly fields (first of all economics, business, operations management, operations research decision sciences) the inventory problem still draws interest from all these corners and is therefore approached from many different points of view. This complexity of ISIR's operation was apparent during the symposium and resulted in two important consequences. First, the General Assembly has decided to set up a task force on the development and sustainability of ISIR. This decision was made not because of the appearance of signs of crisis – on the contrary, because of a feeling of great further potentials seen by ISIR members (details are given in the Minutes of the General Assembly, on page 7 of this Newsletter). It has to be added that there were a number of suggestions for improvement during the session.

Another important development was that several participants have agreed to start a joint research program on the currently acceptable main paradigm of inventory research. Details of the program are being worked out these days, and will be hopefully completed before the next Symposium in 2008 in Budapest.

A good news for all of us is that Elsevier continues to publish the special issues containing Symposium papers. We only have to wait a few weeks now for the publication of the 2004 Symposium papers. Measures are introduced to speed up the refereeing process and thus shortening the publication lead time – we would like to publish the 2006 Symposium papers late next year.

I wish you Merry Christmas and a Happy New Year!

Attila Chikán

FUTURE EVENTS
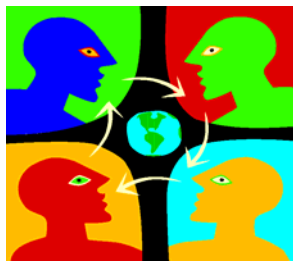
NEXT ISIR Session at the Allied Social Science Associations Meetings

January 5-7, 2007, Chicago, IL, USA

Session Title: Recent Advances in Inventory Research

Chair: George Hall, Brandeis University

Howard Marvel and James Peck, The Ohio State University: *Inventory Turnover and Product Variety*
    Discussant: Adam Copeland, Bureau of Economic Analysis
David Bivin, IUPUI: *Inventories and Interest Rates*
    Discussant: Huntley Schaller, Carleton University
Yongseung Jung, Kyunghee University, and **Tack Yun**, Board of Governors of the Federal Reserve System:
Monetary Policy Shocks, Inventory Dynamics, and Price-setting Behavior
    Discussant: Yongsung Chang, Seoul National University

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Department of Economics, Yale University
P.O. Box 208268, New Haven, CT 06520-8268, USA
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8th ISIR Summer School
July 30-August 3, 2007 – Brescia, Italy

**New and Classical Streams in Inventory Management:
Advances in research and opening frontiers**

The next ISIR Summer School will be organized and hosted by the Department of Mechanical Engineering of the University of Brescia.

The main topics of the Summer School will be classical issues like
1. Analytical modelling and organisation of inventories;
2. Control and management of supply chains;
3. Control techniques: monitoring and performance measurement;
4. Applications of simulation and optimisation techniques to inventories;
5. Logistics.

and dedicated issues:
1. The inventories of special-feature products, e.g.: the management and control of perishable goods (food, batteries, pharmaceuticals etc.); items prone to obsolescence (high tech, fashion etc.); inventories for finished products with value increasing in time (e.g., speculative stocks of raw materials, wines); Health Care and Inventories;
2. Modelling the sustainable Supply Chain: Product Life Cycle: spare parts inventory and management; Models and strategies for the Reverse Logistics; Supply Chains and Energy saving / Emission reduction: supplying and distributing products requiring controlled environments.
3. Cases and studies of "Continuous Inventories": oil, water, chemical products etc.;
4. How Legal and Fiscal aspects may affect the inventory management.

Types of presentations:
Tutorials - approximately 45 minutes each, plus 30 minutes discussion and *PhD student presentations* - 30 minutes each, followed by 15 minutes (senior researcher discussant) and 15 minutes (PhD student discussant).

!!! The announcement of the Summer School with further details will be circulated and posted on the website shortly !!!

14TH INTERNATIONAL SYMPOSIUM ON INVENTORIES
August 21-25, 2006, Budapest, Hungary

ISIR MEETINGS DURING THE SYMPOSIUM

The ISIR Executive Committee members met on the first day of Symposium on Monday, August 21. The General Assembly Meeting was held on Thursday, August 24 in the conference hotel. Please find below the Report of the Secretary General and the minutes of the two meetings.

REPORT OF THE SECRETARY GENERAL
FOR THE PERIOD BETWEEN THE 2004 AND 2006 GENERAL ASSEMBLY MEETINGS

This report summarizes the activities and status of ISIR since August, 2004. The report was first discussed by the Executive Committee then presented to the General Assembly.

1. MEMBERSHIP

ISIR membership dropped to a lower lever six years ago. Though in symposia years the numbers slightly increased, in non-symposia years they stagnated. The EC and the General Assembly discussed the issue and decided that those who paid higher, non-member registration fee will receive two-year "trial" membership in ISIR. At the same time the membership year was changed from calendar year to a term running from September 1 and ending August 31.

Number of ISIR members paying the fee

Year	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96
Members	64	71	85	73	79	89	70	70	116	117	88	98	108	113

Year	'97	'98	'99	'00	'01	'02	'03	'04	'04/'05	'05/'06	'06/'07	07/08
Members	102	123	101	82	74	89	73	81	117 (72+45*)	131 (85+46*)	51**	19**

* the number of trial members
** Before August 1
explanation isgiven in the financial report

2. EVENTS

The following events were organised or co-organized by ISIR in the period covered:

1) 13th International Symposium on Inventories.
  Date: August 23-27, 2004
  Location: Budapest, Hungary
  Participants: 123
  Papers: 100

2) Conference for Hungarian managers
  Date: August 26, 2004
  Location: Budapest, Hungary
  Papers: 6

3) ISIR Session at the Allied Social Science Associations Meetings
  (Coordinated by Valerie Ramey, University of California at San Diego)

  Date: January 7, 2005
  Location: Philadelphia, PA, USA
  Participants: n.a.
  Papers: 4

4) Seventh ISIR Summer School on Supply Chain Inventory Management (Organized by Stefan Minner, Mannheim Business School, University of Mannheim, Germany)

Date: August 14-19, 2005
Location: Mannheim, Germany
Participants: 34

5) ISIR Session at the 2006 ASSA meeting (coordinated by Huntley Schaller, Carleton University, USA)

Date: January 6-8, 2006
Location: Boston, MA, USA
Participants: n.a.
Papers: 3

6) 14th International Symposium on Inventories.

Date: August 21-25, 2006
Location: Budapest, Hungary
Participants:
Papers:

FUTURE EVENTS

1) ISIR Session at the 2007 ASSA meeting (coordinated by Valerie Ramey, University of California, USA)

Date: January 5-7, 2007
Location: Chicago, IL, USA
Papers: 3

2) 8th ISIR Summer School

3. PUBLICATIONS

⇨ Four issues of the ISIR electronic Newsletter were published in November, 2004, June and December, 2005 and July, 2006. (Since 2003 the ISIR Newsletter has come out only in electronic format.)

⇨ The Proceedings of the Twelfth International Symposium on Inventories edited by Attila Chikán was published in January 8, 2005 as a Special Issue of the International Journal of Production Economics, Volumes 93-94. It contains 47 papers selected from the ones presented at the 2002 Symposium.

⇨ The editing process of the papers presented at the 2004 Symposium has been completed. We are in connection with Elsevier about further details of the publication which is expected in early 2007.

4. PROJECTS

No project has been initiated in the reported period.

5. ORGANISATION

No major organisational change happened in ISIR's operation. The EC has operated, as usual, on individual contacts. The Secretariat is operated jointly with that of the Hungarian Association of Logistics Purchasing and Inventory Management, and is financed mostly by HALPIM.

6. INSTITUTIONAL CONTACTS

There has been no change in the institutional contacts of ISIR. We have more or less institutionalized contacts with the following international organizations:

GMRG - Global Manufacturing Research Group
ELA - European Logistics Association
IFPSM - International Federation of Purchasing and Supply Management
EUROMA – European Operations Management Association

7. ISIR SERVICE AWARD AND FELLOWSHIP PROGRAM

In 2004 two new Fellows were approved for receiving this title based on the nomination of the committee made up of the ISIR Fellows. New Fellows of ISIR are: **Louis Maccini** (The Johns Hopkins University, USA) and **D. Clay Whybark** (University of North Carolina, USA).

It was the fifth time that ISIR presented the Service Award at the Banquet of the 2004 Symposium to two ISIR members: **Danuta Kisperska-Moron** (University of Economics, Poland) and **Ton de Kok** (Eindhoven University of Technology, the Netherlands)

The current FELLOWS has formed a nomination committee in 2006 as well and submitted their decision to the SG. The names of the appointed fellows will be approved by the Executive Committee on its meeting on August 21, 2006. Here the suggestion of the Secretary General for the recipients of the Service Award will also be approved.

8. ELECTIONS

At the General Assembly Meeting in 2004 a new President-Elect was elected, Linda G. Sprague. In 2006 the election of new EC members will take place.

FINANCIAL REPORT OF THE ISIR SECRETARIAT

for a period between July 1, 2004 and June 30, 2006

(in USD)

I. Balance of bank account on July 1, 2004			**1483,60**
II. INCOMES			**65168,32**
1	Participation fees for the Symposium 2004 (01.01. 2004-06.30. 2004)	22510,00	
2	Further participation fees for the Symposium 2004	29193,22	
3	Membership fees	8455,72	
4	Support from HALPIM and other Hungarian institutions	4705,38	
5	Other incomes	304,00	
III. EXPENDITURES			**61946,56**
6	Expenditures of the Symposium 2004	46604,40	
7	Salary of the employees and taxes	4536,70	
8	Travelling	5588,49	
9	Bank charges	2178,79	
10	Operational costs of the Secretariat	3038,18	
IV. Balance of bank account on July 1, 2006 (I. + II. - III.)			**4705,36**

I. General Comments

1. Both incomes and costs incurred in various currencies (the majority either in USD or Hungarian Forints). Here everything is given in USD calculated with the exchange rates of the Hungarian National Bank.

2. Figures before the paragraphs below refer to the appropriate item in the balance.

3. The report does not contain USD 21494,50 received before June 30, 2006 as advance payment of participation fees for the 2006 Symposium and the cost of deposit to Hotel Sofitel Atrium, the venue of the symposium.

II. Comments on the various items of balance

1. Participation fee received before the timescale of this financial report that was not included in the previous 2002-2004 one

2. Participation fee received after June 30, 2004

3. The membership fee collected in these two years. The increase compared to 2002-2004 (USD 4426,46) is due to the different membership year introduced from September 1, 2004 (thus the membership term had expired earlier than used to) and therefore this sum already includes 51 membership fee for the 2006/2007 term and 19 membership fee for the 2007/2008 period. One institutional membership fee was paid by Linköping University.

4. Support provided mostly by HALPIM (Hungarian Association of Logistics, Purchasing and Inventory Management) to finance everyday operations and some of the travelling costs. In the year 2004 we received support for organizing the Symposium from the National Office for Research and Technology

5. Other incomes contain mainly interests obtained from short-term deposits.

6. Direct costs of the 2004 Symposium (not covering the overhead) and the conference for Hungarian managers.

7. The ISIR Secretariat jointly operates with the HALPIM Secretariat, which has seven full time and one half time employees. The amount shown is one part-time salary. Other wages are paid by HALPIM.

8. Travelling costs mean contribution to the travel costs of the Secretary General.

9. Bank charges stemming from currency exchange and the use of different payment methods and the different transaction costs associated with them.

10. This is a contribution to the operating cost of the joint ISIR-HALPIM secretariat.

MINUTES OF THE ISIR EXECUTIVE COMMITTEE MEETING

Present:

Avijit Banerjee
Marija Bogataj
Maurice C. Bonney
Attila Chikán
Krisztina Demeter
Moheb Ghali
Robert W. Grubbström
Owen Irvine
Søren-Glud Johansen
Peter Köchel
Anita Kőhegyi
Louis Maccini
Ed Silver
Linda G. Sprague
Ruud Teunter
Vis Vishwanathan
Jacob Wijngaard
D. Clay Whybark
Henk Zijm

Agenda:

1) Report of the Secretary General on ISIR's activity between 2004 and 2006
2) Financial report
3) Awards
4) Election at the General Assembly Meeting
5) Future activities of ISIR / based on the survey completed last year
6) Any other business

1) Report of the Secretary General ISIR's activity between 2004 and 2006

President Jacob Wijngaard welcomed the members of the Executive Committee and the agenda was accepted by the EC. Attila Chikán presented his report. Since the report was distributed beforehand he commented on some major issues:

a. *Membership* – the membership fee structure was changed in 2004 and with the introduction of the new membership year and the new habit of paying the fee for two years ahead has resulted an increase in the amount of fee received. The number of the members did not change dramatically it has mainly increased because of offering trial membership for the non-member participants of the 2004 Symposium.

b. *Events* – the most important events besides the Symposia are the annual ISIR session at ASSA meetings (which enhance the visibility of ISIR overseas, thanks to Lou Maccini for having taken care of this event) and the ISIR Summer schools. L. Maccini added that regarding the ASSA meetings they rather attract American economists, Europeans and other regions would be welcome. The Summer School last year in Germany was a great success, an event of high professional level, thanks to the great organization of Stefan Minner. A. Chikán said that he inquired Professor Lucio Zavanella, the University of Brescia, Italy about hosting the next Summer School in 2007 and he was happy to report that they accepted the invitation.

This year we have 97 foreign and 10-15 Hungarian participants attending the Symposium from a record number of 25 countries!

c. *Publications* – we continued publishing the e-newsletters and just finished the editing process of the Proceedings of the papers presented at the 2004 meeting. According to the publisher (Elsevier) it takes about 6 months to publish it, so it will come in early 2007. R. Teunter commented that it is too long a process and there should be some solutions to shorten it. He suggested to keep the deadlines more strictly, find new referees if someone is not returning within a given a period, more automatic reminders should be sent out to the referees and authors. The idea of introducing formal criteria also came up to be able to speed up the process.

2) Financial report

The major items on this report are related to the Symposia, the membership and the operation of the Secretariat. The latter is mainly supported /financed by HALPIM. There was one question from the Auditing Committee regarding the high bank charges item, which is due to the high costs of accepting credit cards for the payments of the membership and registration fees.

A. Chikán suggested that since in 2004 we changed from USD to EUR in the fee system we should do that in our finances as well. The EC has accepted the proposition.

2) Awards

a. *Fellows* – M.C. Bonney reported on the work of the Fellows who decided to nominate one person, W.Henk M. Zijm, University of Twente for this award. They also decided that the procedure among the Fellows should be formalized, and it will be set up by D.C. Whybark. It was also expressed that more knowledge is needed about the potential participants.

b. *Service Award* – It is the task of the Secretary General to suggest persons for this award. He did so and the nominations were accepted by the EC. This award will be presented also at the banquet. (Their names will be included in the final version of the minutes of the EC meeting.)

3) Election of ISIR Officials

There will be an election during the General Assemby, the slate for which is to be prepared by the Nomination Committee consisting of the President, Immediate Past President and the President-Elect. We have received some nominations for our call sent out late spring, the list of them is provided for the Nomination Committee. It is possible to modify the slate by addition at the General Assemby meeting as well but the nominee has to be present and accept the nomination.

5) Future activities

Based on the survey results published in the ISIR Newsletter in June 2005 J. Wijngaard suggested a discussion of issues having a great influence on the future of the Society. L.G. Spague proposed that a task force of a few people should be set up, who should investigate the survey in detail, articulate recommendations with implications on costs. Main issues requesting further consideration:

a. PhD Students – how to increase their participation, involvement in ISIR's activity and how to make ISIR more attractive for them, with what kind of services? How to encourage professors to bring along their students as well? Should we organize specialized programs like tutorials for them in connection with the Symposia? The Summer School should be definitely maintained and we should communicate it as much as possible how good it is.

b. Website – the content should be enriched to make it as a source of reference for scholars. We should publish working papers, make the list and contact data of members available for networking among each other.
Technically the website is able to accommodate these tasks but the necessary framework (e.g. classification of papers) should be set up.

c. ISIR Symposia – timing came up again, but no specific suggestion better than the end of August was made.

d. Topical workshops should be organized around specific research questions both in connection with the Symposium and independently.

e. It was discussed whether it is good to have the three sections of ISIR. Even though new related subject areas came up (like supply chain management), it seems that this unique feature of the Society of combining the three different research areas is the best we can do.

6) Other issues

Attila Chikán called attention to the establishment of the new International Journal of Inventory Research. ISIR's cooperation was not asked by the publisher or the Editor, but we welcome the initiative and have already made some suggestions of cooperation.

7) President Jacob Wijngaard closed the meeting.

MINUTES OF THE GENERAL ASSEMBLY MEETING

Date: **Budapest, August 24, 2006**
Present: **39 ISIR members**

1) Report of the Secretary General on ISIR's activity between 2004 and 2006
2) Financial report
3) Awards
4) Election at the General Assembly Meeting
5) Future activities of ISIR
6) Any other business

1)-2) President Jacob Wijngaard welcomed the General Assembly. The discussion followed the points of the report of the Secretary General, the highlights of which were presented by Attila Chikán. Following his report Maurice Bonney on behalf of the Auditing Committee commented on the financial report. He noted that the report gave a fair statement of what

had been going on at the Society. Most of ISIR's income had come from the Symposium and membership fees and HALPIM was still essential in running the organization. The bank charges are quite high and are due to the conversion fees and the charges of accepting credit cards.

The General Assembly unanimously accepted the two reports.

3) The winners of the awards were to be announced at the banquet dinner on Thursday evening (see page 10 for details).

4) Election of ISIR Officials – The nominating committee presented a slate of nominees that was voted in three parts – first the General Assembly voted for the President-Elect and the First Vice President, then for section chairs and finally for the members of the Executive Committees and the Auditing Committee. (*The list of new officers can be found on the front page of the Newsletter.*)

5) **Future activities** – The following suggestions came from the members:

- Services offered to **PhD students** should be widened and the registration fee lowered; there should be more events dedicated to them during the symposium like that of Ed Silver's workshops. As for the Summer School, since it is mostly visited by European students, a suggestion arised that a Summer School for US based students should also be organized. The first host is Avijit Banerjee, Drexel University, who volunteered to organize a Summer School in 2009.

- More topical sessions should be organized and the role of the plenary session should be reconsidered.

- The **website** of ISIR should be more dynamic and more categorized information on papers should be

- A **Task Force on the development and sustainabity of ISIR** was set up. Task Force Members are *Owen Irvine*, Michigan State University, USA; *Peter Kochel*, Chemnitz University of Technology, Germany and *Ruud Teunter*, Lancaster University, UK. This Presidential Task Force is charged with

examining the results of the ISIR Survey of the Membership which was prepared and administered in 2004-2005 and developing an analysis of the results, leading to recommendations for consideration by the ISIR Executive Committee. Additional sources of information may be developed. The focus of the analysis and subsequent development of recommendations is to be actions and activities which could be undertaken by the Society to ensure the improvement and sustainability of the ISIR.

- The Task Force shall report interim results to the President of the ISIR in summer 2007. A final report shall be prepared for presentation to the President before the 2008 Symposium of the ISIR and then to the Executive Committee Meeting in August 2008.

- To better communicate the ISIR Symposium there was a suggestion that those who are members in other organizations **put a report about this event in their newsletter.**

- As for new activities the ideas were to organize **workshops on special subjects** with 10-20 people and ISIR session attached to big conferences.

- Regarding the length of the Symposium the idea of having the excursion on the last day came up again. The Secretariat will examine this option.

- It was suggested that **discussants** should be assigned to each paper presented at the Symposium. This proposal has been suggested by several members – we shall make an experiment on this next time.

Dr. Linda G. Sprague, FDSI, FIOM – Inauguration remarks at the banquet

Professor of Manufacturing & Operations Management
China Europe International Business School (CEIBS)
President of the International Society for Inventory Research (ISIR)

It is a privilege and a great honor to have my name added to the list of distinguished predecessors. I hope that I can meet the standards which they have set.

It will also be a pleasure to be working closely with the ISIR Secretariat: their apparent power is something to be viewed with considerable respect if not awe. Those of you who were at the 13th ISIR Symposium in 2004 will recall that, as we began that meeting, the Danube had been rising to dangerous levels for some days. When we arrived at the hotel, the water level was above the road, about to overflow the sandbags protecting the hotel entrance. But – at the exact moment that the Secretary General opened the Symposium -- the water stopped rising and began to recede.

This year, the promised view of the Hungarian National Day Fireworks display from a boat on the Danube was augmented by a "microburst" of torrential rain and 100 mile-an-hour winds – truly an impressive show but another curious coincidence involving the elements and beginnings of an ISIR gathering. One looks forward to the next biannual meeting with anticipation and just a bit of wonder.

The International Society for Inventory Research is a unique organization with a highly focused mission – "…to provide those engaged in inventory research with an opportunity to exchange views and experiences on an international and interdisciplinary basis [and] to provide an appropriate and comprehensive framework for the dissemination of research results attained in the members' countries and to take an initiative in the development of research and higher education."

This mission displays an unusually frank and pragmatic understanding of the profession to which we belong: we are in the business of creation and dissemination of intellectual capital. The ISIR explicitly recognizes the relationship between the two aspects of our work – creation and dissemination. The Society's biannual symposium is focused on dissemination which – I think – fosters the creation of intellectual capital. The presentations are a necessary convention but, to tell the truth, it is the questions and corridor chats (and the Wednesday excursion) which add much of the value.

I must say, though, that describing the ISIR and its activities to "laymen and outsiders" poses challenges. The biannual Symposium with its presentations and the excursion make sense to most people. The content details are another matter.

Last year my son and daughter congratulated me on becoming President-elect of the ISIR, knowing that I've been attending the biannual meetings for a number of years. Over Thanksgiving Dinner, though, they asked for details of what the Society is actually all about. My son is a self-described nerd – software developer; my daughter is a high school guidance counselor.

So, I began describing the ISIR with the fact that the Society membership is grouped into three sections – the economics of inventory, inventory modeling, and inventory management. This did not seem to offer much enlightenment, nor interest. But – eventually -- I was able to provide some insight into the work of the Society's membership: here's what worked.

– explaining what people in our three sections actually do.

There are the people who study inventory in the context of national economies: these are folks for whom "finding the Holy Grail" would be proving once and for all that there is a causal relationship between regional, national and global inventories, and short term interest rates. (I retain the hope that it will be Mike Lovell who achieves this feat.)

There are those who develop mathematical models of inventories: these are the people who regularly face the lively risk that their models will prove sufficiently complex that the lowly little variable inventory will be overwhelmed by the complexity of the other variables of interest.

Then there are those of us who work in inventory management: we are the people who spend inordinate amounts of time in dark, grubby warehouses measuring the levels of dust in an attempt to get decent estimates of real turnover rates, confident in the knowledge that two management fads later -- and two changes of management later – we will be invited back to repeat the exercise under even more harrowing conditions (but at higher rates of pay).

"Aha!" said my son – the computer nerd, "I've got it! Now I know what you do: you're Inventory Nerds: it's the International Nerd Squad!"

But I prefer the designation provided to me by Alan Kantrow – previous Editor of the Harvard Business Review and the McKinsey Quarterly, now Chief Knowledge Officer at The Monitor Group. He calls me an Inventory Maven – a badge I wear as proudly as Inventory Nerd.

I look forward to the next two years of work focused on the future of the Society, followed by seeing you all once again in Budapest in 2008.

AWARDS

NEW FELLOW OF ISIR

According to the rules of ISIR, the Fellows of the Society elected a new member, the name of whom was announced at the Symposium dinner.

Prof. Dr. W. Henk M. Zijm

Rector of the University of Twente, The Netherlands had been named Fellow of the International Society for Inventory Research. This honor was bestowed for:

1. His important influence on inventory theory and management through his research, publications and professional presentations on production planning, inventory control, multi-echelon systems and flexible manufacturing issues.

2. His fostering of the development of colleagues and students by collaborating on research projects, supervising PhD. theses, publishing research findings jointly and in his administrative roles at the University of Twente.

3. His major contributions to practice with his work at Philips Electronics, consulting engagements and management seminars.

4. His support of the development of professional practice in research and application by taking leadership roles in academic and professional societies and, especially, for his service to ISIR where he has been an active presenter, has chaired individual sessions and is a member of the Executive Committee.

2006 ISIR SERVICE AWARD

It was the sixth time that ISIR, in order to recognize the considerable contributions of some colleagues to ISIR over a number of years, presented Service Awards at the Banquet of the 2006 Symposium to two ISIR members.

Prof. Dr. Stefan Minner

Has been an attendant of a number of ISIR symposia. He has done a lot for increasing the visibility of ISIR and served in several functions (referee, chairman etc.). Organized and managed a highly successful ISIR Summer School in Mannheim, 2005.

Prof. Timo Pirttilä

Has been an attendant of the ISIR symposia from the very beginning. He was a member of the ISIR EC in two terms. He has been very active in maintaining a strong Finnish participation at the Symposia by bringing his students and other colleagues to the meetings.
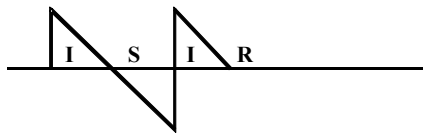
SESSIONS OF THE 14ᵀᴴ ISIR SYMPOSIUM
Reports of the chairpersons

Opening Plenary Session
Monday morning, August 21

The first plenary session started of course with a short welcome address of the Secretary General of ISIR, **Attila Chikán**. It was the fourteenth time he did that. Some of us attended most of these meetings and associate Budapest and Attila and inventory control strongly with each other: a positive and fruitful association.

The morning part of the plenary session was intended to have five papers. Unfortunately, Alan Stenger could not come. He was intending to speak about his 40 years of experience in research and implementation of inventory management. Many of us looked forward to that presentation. We hope he is going to be there next time, to talk about 42 years of experiences in inventory management.

The papers presented were:

Maccini – Moore - Schaller (Johns Hopkins US/Fordham US/Carleton Canada)**: Monetary Policy and Inventory Investment**

Grubbström – Huynh – Bogataj - Bogataj (Linköping/Ljubljana)**: Generalisations of MRP Theory with Non-Zero Lead Times to Continuous Time and Stochastic Demand**

Nahmias - Collins (US)**: A Re-examination of the Risk Averse Newsvendor**

Niemi – Huiskonen - Kärkkäinen (Lappeenranta)**: Understanding the Knowledge Accumulation Process – Implications for Adoption of Inventory Management Techniques**

So, the session covered the three streams: Economics of Inventories, Mathematical Models of Inventory and Inventory Management.

Maccini presented research on the influence of monetary policy, through interest rate, on inventory investment. They used long-run econometric techniques and focus on the pure interest rate effect (the effect of interest rates through the interest charges associated with holding inventories). He discussed the three steps in their research: (1) identify monetary policy shocks, (2) estimate the effect of monetary policy shocks on key interest-rate related variables and (3) trace out the dynamic path of inventories in response to a monetary policy shock. The results were clear, and meaningful for monetary policy makers.

Grubbström gave a history rich presentation. He related the roots of MRP and the roots of input-output analysis and control, the Bill-of-Material and the Gozinto-graph. He referred to the work of Leontief, Vazsonyi and Orlicky. He showed the possibilities in general of input-output analysis and control to deal with MRP problems. He made this more specific by showing how stochastic demand, lead time and restricted capacity can be modeled in an input-output control approach. Ludvik Bogataj added some comments on the mathematics that are required.

Nahmias discussed the newsvendor model with a risk-averse newsvendor. He assumed a utility function based on mean and variance and presented results for various ratios of overage cost and underage cost and for various demand distributions. His results showed also that it is necessary to be cautious in translating assumptions about risk-aversion too easily to this inventory models. It leads to counter intuitive results and to new insights in the character of risk-aversion in this kind of decision situations.

Niemi reflected on the slow diffusion of inventory management techniques. He proposed to apply concepts and results of knowledge management to understand these problems and to construct new way of accelerating the diffusion of inventory management techniques. He developed stages of development of inventory management, inspired by the stages of maturity of knowledge management and organization development in general. He discussed the possibility to operationalise these stages on hand of two case studies. The case studies can be used in this way to identify successful practices for inventory management.

Jacob Wijngaard

Plenary Session
Monday afternoon, August 21

The afternoon Plenary Session continued the style set during the morning Plenary Session. Work from the three Sections of the ISIR – Economics of Inventory, Mathematical Models of Inventories, and Inventory Management – was presented to an audience comprised of the three Sections meeting together.

F. Owen Irvine: "The Great Moderation: Was It Caused by Aggregate Factors or Industry Changes?"

Irvine presented this work on the development of explanations for the decline in GDP volatility after the 1980s – a phenomenon which persists. This report on a project which is a work in process began with presentation of the three most widely published possible explanations: 1) improved monetary policy, 2) "good luck" in the form of less variable shocks and/or 3) improved production and inventory management techniques. The focus of this work is investigation of the extent that reductions in covariance can be explained by aggregate factors by estimating a standard factor model. A factor model with an aggregate and idiosyncratic (industry) shock implies that there will be less co-movement between industries as a consequence of the reduction in variance of common factors.

The analysis shows that the common factors reflect the disproportionate influence of a relatively small number of specifically industries – especially autos, but also oil, capital goods, and food – in determining the variance of overall M&T (Manufacturing and Trade) output. This suggests the need for examination of these groups of industries for changes which may have led to the observed decline in co-variances between industries.

Yoshiki Matsui and Anh Chi Phan: "An Empirical Analysis of Japanese Manufacturing Companies"

Matsui reported on this examination of the impact of Just-In-Time (JIT) practices on the competitive performance of Japanese manufacturers. The research is based on a survey of 35 plants and then comparing these results with similar survey data from the High Performance Project survey carried out ten years ago. Also, the impact of common JIT practices on each performance indicator subjectively judged by the plant managers was examined through regression analysis. The regression models show that JIT practices are significantly related with cost, delivery and flexibility performance. The results also show that – recently in Japanese manufacturing companies – a stable master schedule and equipment layout play important roles in reducing cycle time and manufacturing costs as well as increasing volume flexibility and inventory.

The work also analyzed the relationship among the JIT production system and human resource management, Total Quality Management, suppliers' linkages, technology development and operations strategy.

Rommert Dekker and Eric Porras Musalem: "An Empirical Evaluation of Reorder Point Levels at a Refinery"

Dekker presented this work which was focused on spares inventories of service parts at three manufacturing sites as well as a case study at a 60-year-old refinery with a new automated warehouse. Setting Reorder Points for slow-moving spare parts was the focus of this work. Limitations of the refinery's ERP system were described, including the problem of rounding up forecast estimates.

Peter Köchel: "Simulation in Inventory Theory"

This presentation was focused on *systemization* of simulation applications in inventory theory. An objective was consideration of the possibilities for combining simulation with optimization algorithms. A very general classification scheme was introduced – grouping the approaches to *simulation optimization* into prospective and retrospective methods.

The non-recursive or retrospective approach was described as a decoupling of simulation and optimization. A recursive or prospective approach was described as an interactive procedure with no full decoupling of simulation and optimization. The limitations of genetic algorithms were noted – long computation times and no convergence proofs. Simulation/optimization software was described as a set of tools to support the modeling of inventory and also to support simulation experiment design.

Josep A. Tribo Gine: "The Effect of Operations Managers' Dual Role on Inventory Policy"

This work was focused on the fact that Operations Managers' decisions are becoming increasingly strategic in the nature. A simple model was

developed where Operations Managers are compensated when they achieve two complementary goals: first a reduction in inventory costs and second an increase in managers' efforts linked to the development of a firm's strategy. An objective of the research is to prove that the use of Operations Managers on strategic tasks can decrease their incentives for behaving opportunistically on the

management of inventories. The work concludes with the observation that if Operations Managers undertake tasks with more strategic content, they will have less incentive for behaving opportunistically in their core inventory management responsibilities.

Linda G. Sprague

Section 1: Economics of Inventories

E1 – Tuesday morning, August 22

Three papers were presented in this session:

Attila Chikán and Erzsébet Kovács: Inventory Investment and GDP Characteristics in OECD Countries

This paper analyzes the relationships between inventory investments and GDP data of fourteen OECD countries. This is a follow-up to the studies presented at the 2002 ISIR Symposium where the authors had concluded that even though there is a generally declining trend of the inventory investments/GDP ratio in the developed countries, no general regression model was found to explain inventory behavior in different countries. However, some generalized statements about the correlation between inventories and other macroeconomic parameters were possible. In this current paper the authors revisit some of the hypotheses advanced in the earlier paper and examine some new ones. The authors report that the basic trends shown earlier seem to continue over a longer time period. The data presented shed more light on the validity of the thesis that over a longer period of time different countries follow the same global trends.

Marco Malgarini: Inventories and Business Cycle Volatility: An Analysis Based on ISAE Survey Data

The paper examines the decline observed in business cycle volatility from the point of view of qualitative data available in the *Business Tendency Surveys*. Considering the manufacturing sector, the author provides evidence that the volatility slow down is attributable to a break in the Data Generating Process rather than to a long trend decline. The lower variance of the ISAE Confidence Indicator is mostly explained by the behavior of firms'

assessments of demand and inventories. Three main alternative explanations may be advanced for these findings, (a) sounder monetary policies, (b) the IT revolution enabling better inventories management, and (c) "good luck".

The author finds support for the hypothesis that technological innovation may have played a relevant role in moderating volatility. As a confirmation, the author argues that volatility of inventories has decreased, and that the volatility of production has increased, relative to that of demand. Both of these results are consistent with the claim of a specific role for better inventories management in shaping production decisions of the firms.

Sanda Poljaković and Marija Bogataj: Statistcal Analysis of Differences in Inventory Investments Significant for SEE Countries

The authors used the AMADEUS Database, United Nation's National Accounts Main Aggregates Database, and KOBSON Database to perform statistical analysis of relations between inventories and other macroeconomic indicators for South- East European (SEE) countries. Some hypotheses to explain the differences between the group of developed countries and the SEE countries are tested. The comparison is made between the results presented by Chikan et al in the paper: *Macroeconomic Characteristics and Inventory Investment: a Multi – country Study*, which are valid for the most developed countries, and the results of the statistical analysis of inventory behavior in SEE countries. They found some similarities and some differences between the two groups of countries.

Moheb Ghali

Arup Daripa and Jeffrey Nilsen: Subsidizing Inventory: A Theory of Trade Credit and Prepayment

In the first presentation **Arup Daripa** proposed a simple theory of trade credit and prepayment on the basis of a paper written with **Jeffrey Nilsen** In their scenario a downstream firm trades off inventory holding costs against lost sales. Lost final sales impose a negative externality on the upstream firm. The solution requires a subsidy limited by the value of inputs. Allowing the downstream firm to pay with a delay, an arrangement known as "trade credit," is precisely such a solution. Further, solving a reverse externality accounts for the use of prepayment for inputs, even in the absence of any risk of default by the downstream firm. Daripa explained why trade credit is short term credit and why the level of provision is negatively related to sales and profit and inventory, but positively related to the profit margin. As a by-product of the analysis, the author have shown that under trade credit inventory investment is invariant to the real interest rate for a wide range of parameters.

Inventory-Sales Ratios at U.S. Auto Dealerships: Why Does Days' Supply Differ so much between Brands?

The second presentation arrived from the popular automotive industry. **Daniel J. Vine and Wendy E. Dunn** researched why days' supply differed so much between brands. As they found, days' supply at the traditional Big Three producers (General Motors, Ford and Chrysler) averages about 70 days, while the three largest foreign producers with operations in North America (Toyota, Honda and Nissan) hold only about 50 days worth of sales in inventories. The presentation examined the firm-level dispersion of average days' supply held at U.S. dealerships, and, building on empirical studies of endogenous inventory-sales ratios, it assessed a range of factors that can explain this dispersion.

Firms' Stock Market Flotation: Effects on Infventory Policy

The third presentation by **Josep A. Tribó** suggested that firms that are floated on the stock market have more resource availability to finance their investment projects and do not need to use inventories as a strategic tool in order to prevent liquidity shocks (liquidity effect). Moreover, since they are subject to close scrutiny by the financial markets, listed firms are prevented from implementing the type of empire-building overinvestment policy that may generate inventory accumulation (disciplinary effect). The main hypothesis of the presentation, which was confirmed by the analysis, was that once a firm is listed on the stock market, there is a decrease in its inventory level as well as in its inventory variability. The presenter addressed three extensions of this basic topic related to a) the characteristics of the ownership structure emerging after the flotation, b) the effect on inventory policy of subsequent share issues by listed firms and c) to the form of inventories (final-good or intermediate-good) accumulated.

Section 2: Inventory Management

Buyer – Supplier Cooperation and Negotiation Support under Random Yield Consideration

Collaborative planning, alignment of the supply chain by optimizing the relationship, and processes between suppliers/manufacturers and distributors can provide a win-win environment. Several quantitative and qualitative results have been published recently on the coordination and cooperation between buyer and supplier suggesting joint channel-optimal ordering/shipment policies under different assumptions. However, most of them were considering a determi-

nistic environment with known parameters. **Peter Kelle, Stefan Miller and Sandra Transchel** have contributed to this research considering the effect of random yield on the buyer-supplier coordination in their presentation. First they have checked the effect of yield uncertainty on the optimal policy for the buyer and supplier separately for different situations on the detection of the failure rate in the output. Next they have examined the effect of yield uncertainty on the joint optimal ordering-shipment policy if the two parties are ready for cooperation. In most cases a

bargaining is required to get concessions from the dominant party. The quantitative results of the authors serve as a motivation and negotiation support for partners to cooperate and coordinate their decisions.

How can RFID Improve Periodic-Review Inventory Systems Subject To Theft?

Inventory record inaccuracy, the discrepancy between the recorded inventory quantity and the actual inventory quantity physically present on the shelf, is a substantial problem in retailing. In his model **Yacine Rekik** has assumed that inventory inaccuracies are introduced by theft type errors that occur within the store. He considers Radio Frequency Identification (RFID) as a possible technology to prevent inaccuracy and theft.

The author proposed a comparison between three "Approaches": 1) the inventory manager is unaware of errors in the store; 2) he focused on the benefits achieved through a better knowledge of errors and through taking them into account when formulating and optimizing the inventory system; 3) he focused on the contribution of a perfect RFID technology that prevents errors. To solve the problem, the author followed two methods: i) Optimization of holding costs under a service level constraint where analytical results are provided and ii) Optimization of short-

age and holding costs where dynamic programming approach is used.

Simultaneous Determination of Multiproduct Batch and Full Truckload Shipment Schedules

A fundamental premise of the well-known economic lot scheduling problem (ELSP) is that the finished products are consumed at continuous rates. This implies that retail market demands for these products are satisfied directly from the manufacturing facility. In today's supply chains, however, employing complex distribution networks, finished goods inventories from manufacturing plants are usually shipped in bulk to succeeding stages along the distribution process. Moreover, existing transport economies often tend to favour full truckload, rather that partial or less than truckload shipments, for efficient movement of such goods. In his presentation **Avijit Banerjee** recast the classical ELSP problem under discrete inventory withdrawals in sizeable lots. First, we propose a generalized mathematical model for developing a multi-product batch production schedule, which coordinates finished goods availabilities with their outbound bulk shipment plans. Two special cases of this general model, involving two distinct shipping tactics, are examined in close detail. Finally, the models and the concepts developed in this study are illustrated through numerical examples.

IM2 – Tuesday morning, August 22

Three papers were presented in this session. The first of these, entitled "**A Study of Connections between Work-In-Process, Produced Production and its Lead-Time when Processing Times are Stochastic**" (co-authored by **Jan-Arne Pettersen and Anders Segerstedt**), was presented by Anders Segerstedt. A major contention of this paper is that the CONWIP (constant work-in-process) protocol is superior to the pull-based Kanban system for production control purposes. Furthermore, from the standpoint of overall system performance, it is crucial to restrict and control the level of work-in-process (WIP). A set of simulation experiments are performed on a five-machine production system, where all jobs require processing on each of these machines in the same sequence. Although the actual time taken to process a job on a machine is a random variable, the average processing time for each job on each machine is set to 60 minutes. The techniques of CONWIP and Kanban are employed under a variety

of operating environments, involving the amounts of available work-in-process storage spaces and their locations within the system (essentially defining various levels of maximum allowable WIP).

The system performance measures collected and examined include the average time between the completion of consecutive jobs, the mean time spent by the jobs in the system, the total number of jobs processed over 48,000 hours, the standard deviation of the time between completion of consecutive jobs and the standard deviation of the time spent by jobs in the system. The results of the simulation experiments indicate that, in general, CONWIP tends to be superior to Kanban in terms of all the performance criteria considered, especially under conditions of restricted maximum WIP. Also, overall system performance tends to improve under both the control systems employed as the maximum allowable WIP is increased. Nevertheless, such improvements tend to level off and the difference between CONWIP

and Kanban diminishes with increasing maximum WIP. These results provide substantive support for the contentions made by the authors.

The second paper of the session, "**The Optimal Production and Shipment Policy for the Single Vendor, Single Buyer Integrated Production-Inventory Problem for a Decreasing Demand Process**", was authored and presented by **Mohammad Omar**. This paper focuses on a supply chain involving a single manufacturer, which produces a single product and satisfies the demand from a single buyer, through batch production and discrete lot deliveries. The production-distribution environment is assumed to be deterministic. It is further assumed that the demand at the buyer's end is declining at a linear rate, eventually reaching zero at some determinable point in time in the future. In the scenario described the vendor and the buyer collaborate through information sharing and the benefits that accrue due to such collaboration are also shared by the two parties.

Under the aforementioned assumptions, a finite horizon optimization model is developed, incorporating the relevant fixed costs associated with setups and deliveries, as well as the inventory carrying costs for both the buyer and the supplier. The basic premise is that the vendor is to manufacture one final production batch, as demand declines linearly from its current level to zero, and deliver equal sublots to the buyer at unequal (i.e. increasing) intervals. It is acknowledged, nevertheless, that such a policy may not necessarily result in the globally optimal solution, which is likely to result from unequal lots delivered at unequal intervals. The concepts developed are illustrated through a simple numerical example.

The final paper of the session, "**An Integrated Approach to Inventory and Flexible Capacity Management under Non-Stationary Stochastic Demand and Setup Costs**", co-authored by **Tarkan**

Tan and Osman Alp, was presented by the first author. This work examines a periodic review, make-to-stock production environment under non-stationary stochastic demand. It is assumed that although the "permanent" capacity of the system, based on the existing resources available, is fixed, additional "contingent" capacity can be obtained, as needed, by acquiring contingent internal and/or external resources on a temporary basis. Under this scenario, a finite horizon dynamic programming model is suggested which integrates the operational decisions involving both production-inventory and capacity management issues. The proposed model allows for setup costs resulting from initiating production in any period, as well as from ordering contingent capacity.

It is shown that this problem is equivalent to the classical capacitated production/inventory problem under a specified production cost function. Furthermore, when the setup costs are negligible, the optimal policy is dependent on the level of the initial inventory and takes the form of a base-stock type policy. Under positive setup costs, the optimal policy is shown to be a variant of (s, S) type policies. In this case, the policy variables are functions of the beginning inventory level and the limits on the permanent and contingent capacities. Numerical analysis shows that the optimal policy, as well as the monotonic relationship between the initial inventory and the optimal production quantity for the single-period model does not necessarily hold in the multi-period case. The analysis leads to a number of useful insights in terms of the procurement and appropriate use of flexible capacity, with the assertion that under conditions of high demand volatility, the value of additional capacity can be considerable, even in the presence of abundant permanent capacity. Finally, some useful directions for future research in this area of study are outlined.

Avijit Banerjee

IM3 – Tuesday afternoon, August 22

Jukka Korpela - Kalevi Kyläheiko - Antti Lehmusvaara: How to Orchastrate Global Supply Chain: Some illustrations in terms of DEA and AHP methods

The question of optimally orchestrating global supply chains and warehouse networks is becoming a critical

success generating factor in the global economy. In order to analytically cope with this issue supply chain management literature has taken steps towards economics-based reasoning. Modern transaction cost economics offers a useful point of departure for an attempt, which makes it possible to take into account also

subjectively valued qualitative determinants behind the optimal supply chain formation.

The paper introduces this topic into the logistics research agenda. The starting point is a *supply chain-related transaction cost approach*, which can be formalized in terms of the *analytic hierarchy process* (AHP) approach and optimized in terms of the data envelope analysis (DEA). A flexible analytic model is launched through which a decision maker can easily cope with multi-faceted issues of designing a supply chain.

According to the authors every serious supply chain strategy has to be based upon a careful evaluation of the most important firm-internal and environment-related factors. The transaction and management cost criteria cover just these factors. Interestingly enough, traditional direct logistics cost-related mini-mizing models only capture the most evident static determinants, which are, however, critical only in the fairly certain and simple decision situations. From this perspective, it is strange that the very idea of governance costs is largely omitted in strategic sup-ply chain management literature.

Lei Yu Jiang - Kimmo Suojapelto - Jukka Hallikas - Veli-Matti Virolainen - Ou Tang: Value Network within ICT Industry from Supply Chain's Perspective – A case study of the major Chinese ICT players

Asia, especially China plays a significant role within ICT segment since it has become a major supplier for the ICT industry and in the meantime it has a large customer market that is growing very fast compared to every other market area in the world.

The paper first investigated the value network activities in ICT in the Chinese market from the supply chain perspective. The value network for the ICT industry was outlined. The importance of the ICT industry in Asia was examined in detail accompanied with the investigated data from some major Chinese ICT players. At the same time, how the individual key players placed in the ICT value network were revealed. Finally, some conclusions were drawn to substantiate the ICT value network in Asia and some suggestions for future research within ICT value network will be made.

IM4 – Thursday morning, August 24

The first paper in this session, "**An Empirical Analysis of managerial Approaches to the Role of Inventories**", was written and presented by **Attila Chikán**. He argues that fundamental changes in the business and economic environment have emerged. Focus on competitiveness, functional integration, process orientation and network view are leading to a new paradigm of inventory management. The new paradigm has three characteristics. First, the inventories should be seen as integrated part of the value chain, not as stand-alone entities as seen. Secondly, the inventories should be seen as strategic tools, not only simple buffers. Thirdly, more complex performance measures are required, the traditional way to see the inventories only from costs perspective is not enough. The paper presented the results of a survey conducted at 54 Hungarian manufacturing companies aiming at to find out the managerial perceptions to inventories. The results supported the hypothesis about the changing role inventories. Even though the survey results are not reliable enough to draw convincing conclusions, they are promising enough to continue research on the new paradigm of inventory management.

The second paper, "**A proposal for Inventory Adjustment using "Multiple Layers SEC-CIS Model"**", written by **Tomofumi Sumita, Masahito Shimazaki and Keisuke Matsuyama**, was presented by Tomofumi Sumita. The paper discussed the idea of the inventory adjustment system corresponding to the situation beyond the span of control by mathematical models. The model is based on a "Multiple Layers SEC-CIS Model" explaining breeding knowledge value based on the communication between organizations. The basic idea is that the sending and receiving information is a change process of information from tacit knowledge to explicit knowledge. The paper presented as an example how the model can be used to describe a bargaining situation concerning inventory levels.

The third paper "**Justice System Process as Supply Chain – Analysing Throughput Times, Queues and Capacity Bottlenecks**", written by **Petra Pekkanen, Johannes Pekkanen and Timo Pirttilä**, was presented by Johannes Pekkanen. Authors had used analyses based on logistics principles (e.g. throughput-time analysis, work-in-

process analysis) in the case court as a help in identifying areas for improvement and in determining potential solutions. The divisions of the court will primarily use the analyses to control and follow up the throughput-times by allocating the capacity more efficiently to the handling of the large and more complex cases. The study showed that supply chain tools like age distribution analysis can also be used in untypical environments. For the top-management the analyses gave opportunities to compare the

performance of different divisions, use better performing divisions as benchmarks for good practices, allocate resources and to determine the needed changes in performance indicators. The study also showed, that the difficulties to implement supply chain tools can be quite different than in industrial environments. Reported study was a pilot-study and the research of justice system processes in Finland is going to be continued.

Petri Niemi

IM5 – Thursday morning, August 24

The fifth inventory management session of the ISIR symposium proved to be a lively session and contained some interesting ideas.

The first paper, **'Optimal procurement Portfolios when using B2Bs: A Model & Analysis' by Prabhu Aggarwal, Tonya Boone and Ram Ganeshan**, was presented by Ram Ganeshan with Prabhu Aggerwal adding occasional extra comments.

B2Bs are online markets where buyers and sellers trade products in the spot market or via derivative instruments such as option contracts. B2Bs set up a new procurement channel to alleviate demand risk but they expose managers to price volatility. Essentially the paper examined how to integrate physical transactions with paper transactions. It did this by modelling a procurement manager satisfying demand over a two period time horizon by buying and exercising options on the B2B or by trading directly on the spot market. The model computes the options and the physical quantities of the product to purchase so as to minimise the procurement and inventory costs over the two periods.

The second paper, **'Inventory models incorporating retailer and customer incentives for remanufacturing a recycled product'**, by **Avijir Banerjee, Xiangrong Liu and Sreung-Lae Kim**, was presented by Avijit Banerjee.

Used products e.g. used inkjet printer cartridges can be collected from customers via returns to the retailer for remanufacturing and resale. The rate of availability is dependent on the incentives given to customers and the incentives to retailers for collecting and returning to manufacturers. The paper developed mathematical models for a single manufacturer and a single retailer involved in the

production and sale of a single recoverable product. The aim was to determine optimal decisions about inventory replenishment, retail pricing and reimbursement to customers for returns from the point of view of maximising the profits of the retailer, the manufacturer and the entire supply chain. There would appear to be many developments of these ideas that would be useful for the future.

The third paper '**Agile Capabilities of Polish companies in the Supply chain**' by **Danuta Kisperska-Moron and Artur Swierczekj** was presented by Artur Swierczek. The concept of agility in a supply chain is not well known in Poland. The paper reported a survey of 104 Polish companies using a 50 question questionnaire. The survey was carried out in the first half of 2005. The aim was to identify and analyse the main capabilities of companies in supply chains and how these affect inter-organisational agility. Four main factors were considered: the relation of the company a) with its main customers, b) its main suppliers/service providers,) its main competitors and, finally d) the level and intensity of IT use within the company.

Three hypotheses were tested, namely that: co-operation with partners, the use of logistic flow management and, thirdly, the use of IT, were critical success factors. The analysis allowed the 104 companies to be sub-divided into 2 sets: the more agile and the less agile companies. On the basis of the surveyed data it was found, possibly as a consequence of the categorisation, that the more agile companies were stronger in the three chosen aspects. A follow up that examines changes over a period of time and how these affect performance will be an interesting research study.

Maurice Bonney

IM6 – Thursday afternoon, August 24

This session contained three presentations. All of the presentations focused on various problems of transshipments.

M. Tzur – R. W. Lien – S.Iravani – K.Smilowitz: Efficient and Robust Design for Transshipment Networks

In her presentation Tzur considered transshipment as the sharing of inventory among locations at the same echelon level of a supply chain. Retailers that are supplied from the same warehouse can rely on collaboration with other retailers, instead of relying solely on their own inventory or on costly emergency replenishment from the warehouse. Transshipment can achieve the benefits of risk pooling to meet uncertain demand while maintaining low inventory levels at individual locations. Advances in information technology and information sharing have facilitated the use of transshipments.

First analytical results were presented to show that the chain configuration is more efficient than the grouping configuration that appears frequently in the literature. Second, using a numerical study, they analyzed the characteristics of a wider range of configurations under a range of cost and demand uncertainty conditions. They also provided managerial insights on the parameters that affect the configuration choice. Motivated by these results, finally they developed properties of low cost and robust transshipment networks and captured these properties in a metric to facilitate design choices for transshipment. The effectiveness and robustness of this metric was also demonstrated.

When to use decentralized stocks and lateral transshipment in spare parts networks for high-tech equipment

In the second presentation **A.A. Kranenburg, A.A. Scheller-Wolf, and G.J. van Houtum** considered a number of local warehouses that observe demand for expensive, slow-moving items, and that have to satisfy constraints with respect to the maximum expected waiting time to meet a request. Stock in the local warehouses can be replenished from an ample source, with non-zero lead time. It can be expected that in our setting, some form of pooling between the local warehouses would be beneficial. In this presentation, the authors compared three situations with closed queueing network representations for the three alternative situations, which yield exact closed-form stationary distributions and costs: 1) local warehouses that act as separate stock points, without pooling; 2) a pooled inventory by means of a joint warehouse instead of having stock in the local warehouses; 3) local warehouses that carry stock and that share their inventory by means of lateral transshipment. Important findings are the large savings of Situation 3 compared to Situation 1, and the relatively small difference between the cost of Situations 2 and 3 (both forms of pooling), once Situation 2 is feasible.

Optimal Policies for Inventory Systems with Lateral Transshipments

Fredrik Olsson in his presentation dealt with a single-echelon inventory system with two identical locations. In his model demands were generated by stationary and independent Poisson processes. First, he assumed that the locations are identical and applied continuous review (R,Q)-policies. He distinguished two cases. In the first case he assumed that each item in the ordered batch will arrive after different exponentially distributed times. In the second case he assumed that when a batch of size Q is ordered, the whole batch arrives at the same instant of time after an exponentially distributed time. *Second*, he relaxed the assumption of (R,Q)-policies and derived the optimal replenishment policy using stochastic dynamic programming. In his numerical study he found that an (R,Q)-policy may be a reasonable choice of replenishment policy when the demand rate is relatively low.

IM7 – Friday morning, August 25

There were three presentations during the session:

Charles J. Corbet and **Jan C. Fransoo: Entrepreneurs and Newsboys**

The first paper aimed at empirical determination of the extent to which entrepreneurs use newsvendor logic in their inventory decisions. On the basis of literature review a simple model of newsboy-type decision making has been presented. Further on the results of the survey conducted in 30 small companies questioning over 50 enterpreneurs were

summarized. The major findings indicated that enterpreneurs' risk profiles are consistent with predictions from prospect theory, but these risk profiles do not appear to have a consistent effect on their deicisions. Enterpreneurs follow the general logic of the newsboy problem but not necessarily the exact formulas.

Lisa Gimpl-Heersink, Jurgen Gimpl and Alfred Taudes: An Extended Pricing and Inventory Control Model

The second paper reported some of the results of the international project funded by the Vienna Science and Technology Fund. After short presentation of the whole framework of the project the details of a study on a specific inventory model, where demand is sensitive to the firm's pricing history. The direct analysis was based on a single item, periodic review model of a monopolistic firm in a market in which pricing and inventory/production decisions are made simultaneously. The authors showed the optimality of a base stock list price policy depending on the state's reference price in the case of zero fixed ordering costs.

Finally numerical examples were given for loss seeking consumers and positive fixed ordering costs.

Ali Cheaitou, Christian van Delft, Yves Dallery and Zied Jemai: Capacitated Two-Period Production and Inventory Model with Backorders, Multiple Salvage Opprotunities and Production Modes

Third paper was also based on the newsvendor model that originally described goods type of products and uncertain single period demand. The presenter described the evolution of the basic model towards two-period models still with limited flexibility and reactivity. In the paper a new two-period production and inventory model was presented based on the dynamic programming approach. Also some examples of numerical insights were given. The conclusion of the analyses made with the use of the model indicate that the proposed model is more reactive and flexible and allows also to formulate an optimal policy for the second period. The presenter demonstrated also some perspectives for further research like introduction of multi-product case with shared capacities and forecast updates.

Danuta Kisperska-Moron

IM8 – Friday morning, August 25

The session was a "one man show" when Professor Zavanella from University of Brescia very interestingly launched the paper of **Zavanella, Zanoni and Pasotti** about the old **Consingment stock problem** in a modern set up. The presentation was very well built up and utilized effectively all the modern technological facilities when they demonstrated different kinds of simulations etc.

The presentation focused on the main issue of how the firm can effectively utilize Vendor Managed Inventory policy option when monitoring and controlling different inventories between the partners of the supply chain. All the complexities relating to the single-vendor and multiple-buyer productive situation were analyzed by means of helpful graphical illustrations. Professor Zavanelli concluded his lively presentation by showing that the integrated consignment stock policy works better than independent optimization.

After the presentation there were very lively discussions about the pros and cons of the model introduced. Interestingly, this last session of the Conference was also a success as for the amount of the listeners and discussants. It was an easy and enjoyable job to be the chair of this session.

Kalevi Kyläheiko

Forecasting Inventories

FI1 – Tuesday morning, August 22

This session included three presentations.

Mohammad M. Ali and John E. Boylan: "Demand Information Sharing and its Effect on Inventory" (presented by Mohammad Ali)

Recent research suggests that sharing demand information between the various channel members in a supply chain, e.g. between a retailer and a manufacturer, does not have significant value for the upstream channel member in reducing inventory costs; this means that investing in costly systems that transfer point-of-sale information, for example, would be useless. However, the assumptions under which these results are obtained are very strict. For example, one assumption is that the demand model is known both by the retailer and the manufacturer. The authors argue that these assumptions should be relaxed in order to obtain more realistic results; their research objective is to show that exact downstream demand inference is not possible. Using a two-stage supply chain model, an ARIMA demand process and a periodic review, order-up-to policy, the authors investigate four supply chain models. In each model the assumptions are further relaxed (part of it was not yet finished at the time of the presentation). Their study shows that less restrictive assumptions reduces the possibility for the manufacturer to accurately infer the demand at the retailer, so that sharing demand information becomes more valuable for inventory costs reduction.

Gerald Reiner and Johannes Fichtinger: "Demand Forecasting for Supply Processes in Consideration of Pricing and Market Information" (presented by Gerald Reiner)

The authors present a dynamic model to evaluate supply chain process improvements, obtained by applying different forecasting methods. They show that, in addition to the bullwhip effect, it is worthwhile to consider additional performance measures like the fill rate and the average on hold inventory; in particular they define and apply a robustness criterion (range of observation periods above a certain service level). Quantitative forecasting methods and price variation, both to be considered

responsible for the bullwhip effect in supply chains, are used in an extended dynamic demand forecast and inventory model for a two stage supply chain process. The authors illustrate their approach using an empirical data set of an Australian retail chain company. They show how the application of the model can be used to evaluate the performance of the supply process. The influence of demand modelling on supply chain process performance is investigated by comparing several demand models. In particular reference prices are incorporated in the demand model; since these are not directly observable, these prices are obtained by an exponential smoothing procedure that takes a weighted average of the most recent price and the previously determined reference price. Furthermore both the positive and negative gap between the true prices and the reference prices are incorporated in the demand model.

Liljana Ferbar, David Čreslovnik, Blaž Mojškerc, Martin Rajgelj: "Demand Forecasting Methods in a Supply Chain: Smoothing and Denoising" (presented by Blaž Mojškerc)

This presentation deals with the effect of forecasting on the costs in a centralized supply chain with a manufacturer and a retailer. Supply chain costs are supposed to be composed of inventory cost and penalty cost due to end-of-period stockout. Essentially two different forecasting models are compared: simple exponential smoothing, and a 'wavelet denoising model' that applies a discrete wavelet transform (DWT) to an empirical demand series to find the possible trend of the demand and its noise. Roughly, the proposed method involves three steps: (1) decomposition of the signal into an approximation and a detail using multiple DWT, (2) manipulation ('thresholding') of the detail coefficients, and (3) reconstruction of the signal using inverse DWT. Based on Monte Carlo experimentation the authors claim that the wavelet denoising model is the most cost effective way of forecasting, in general.

Leo Strijbosch

FI2 – Tuesday morning, August 22

This session had three interesting papers. First **Aris Syntetos** presented the paper entitled "**Forecast support systems for intermittent demand items**". The paper is joint work with Kostas Nikolopoulos, John Boylan, Robert Fildes and Paul Goodwin. While earlier studies have empirically compared the performance of various approaches for forecasting intermittent or lumpy demand, no results have ever been reported on the performance of human adjustments to statistical forecasts of such demand patterns. This study considers a commercially available forecast support system and compares the performance of the statistical forecasts generated by the software against the final forecasts obtained after the managers have qualitatively (judgementally) adjusted the software output. The data used for the purposes of this investigation come from the UK branch of a major international pharmaceutical company. The preliminary results indicate a benefit obtained from the human adjustments although there is no "learning effect", i.e. the performance of the adjusted forecasts does not improve overtime. The authors are presently undertaking more work to understand the stock control implications of judgementally adjusting statistical forecasts.

The second paper entitled "**Forecasting intermittent demand**" was presented by **Ruud Teunter**. This paper is joint work with his former MSc student Laura Duncan. In this study, methods for forecasting intermittent demand were compared using a large data set from the Royal Air Force of UK. The presentation reiterated the point that the traditional per period error measures of forecasts used in many studies in the literature are not appropriate for intermittent demand. By comparing target service levels to achieved service levels when inventory decisions are based on demand forecasts, the authors show that Croston's method and a variant and bootstrapping outperformed moving average and single exponential smoothing. Finally, it was shown that the performance of Croston's and the bootstrapping technique are further improved by taking into account the fact that each lead time starts with a demand.

The final paper entitled "**Impacts of different types of sales forecast errors on production planning and inventory management**" presented a framework for measuring the impact of forecast errors on production and inventory planning based on a case study. The paper presented by **Annastiina Kerkkanen** was coauthored with Jukka Korpela and Janne Huiskonen. The framework consists of three steps. In step 1, the planning flow between forecasts and sales is identified. In step 2, mismatches between critical points of the planning flow are analyzed. Finally in step 3, error profiles of demand forecasts are defined. For the specific case that authors studied, timing errors of forecasts were not hazardous as other kinds of errors, as forecast were primarily used for capacity planning. The authors developed a method to screen out such timing errors.

Vis Vishvanathan

FI3 – Tuesday afternoon, August 22

This session consisted of two papers, both co-authored by **M.Y.Jaber**, **M.Bonney** and **I. Moualek.** Owing to unforeseen circumstances, Mohamad Jaber was unable to attend the Symposium, leaving Maurice Bonney to present both papers. Maurice gave a disclaimer at the beginning of the talk, saying that he was not as conversant with the technical material as his co-authors. As his presentation progressed, it was evident that this disclaimer was unnecessary.

The papers were entitled **"An economic order quantity model for an imperfect production process with entropy cost"** and **"Lot sizing with learning, forgetting and entropy cost"**. The two papers are closely linked, and were presented together. The concept underpinning this research is "entropy cost". Entropy is a measure of the degree of disorder in a system. In an inventory system, entropy costs are associated with maintaining the system so that disorder does not increase. This may include costs such as maintaining stock records and stock checking.

In the first paper, EOQ models were examined for production processes generating defects requiring reworks. The EOQ model (with reworks) of Porteus (1986) was extended by incorporating entropy costs.

The extended model leads to larger economic order quantities, since it is cheaper to control larger batch sizes than it is to control smaller batch sizes, for both perfect and imperfect processes.

In the second paper, a model of learning and forgetting was considered. The 'learning curve' effect is shown by increased rates of production, as members of staff become more accustomed to a production process. However, the 'learning curve' is not monotonic in practice, as there may be dips in production rates when new staff are employed or when new technology adopted. These interruptions are termed 'forgetting'. By incorporating considerations of entropy and of learning and forgetting, the authors extended the classical EOQ model. The model shows that poor control increases costs and suggests ordering in larger lots to counter entropy effects. However, good control systems that reduce the entropy cost lead to batch sizes not being increased.

John Boylan

FI4 – Thursday morning, August 24

This session had three very interesting papers. First **Stefano Saetta** presented the paper entitled "**Evaluating the impact of integration between forecasting and stock control on the performances of coordinated replenishment policies**". The paper is joint work with Lorenzo Tiacci. Stock control systems are usually examined independently of the demand forecasting systems. Nevertheless, it is important to understand the interactions between demand forecasting and inventory control since this influences the performance of the overall system. In this paper an approach for evaluating these interactions, based on a comparative simulation test of "global" system costs using historical data, was presented. The approach was explained through a real case. The results of the simulation study show that traditional measures of forecast errors cannot be taken as sole indicators for the choice between different demand forecasting methods. These methods, on the contrary, have to be evaluated on the basis of total costs and service level of the global inventory system.

The second paper was presented by **Vish Viswanathan** (joint work with Handik Widiatra and Rajesh Pilpani) entitled "**Forecasting aggregate demand: an analytical evaluation of top-down versus bottom-up forecasting in a production planning framework**". This paper evaluates the relative effectiveness of top-down and bottom-up strategies for forecasting the aggregate demand in a production planning framework. In the former case, the forecast of the aggregate demand is obtained directly using the relevant historical data whereas in the latter case the forecasting is carried out individually for each sub-aggregate component (SKU) that forms part of the aggregate demand. The researchers showed analytically that there is no difference in the relative performance of the two strategies when the time series for all the sub-aggregate components follow a first order univariate moving average [MA(1)] process with identical coefficients of the serial correlation term. For non identical coefficients, they also showed, by means of simulation, that the difference is relatively insignificant when the correlation between the sub-aggregate components is small or moderate.

Finally, **Elleke Janssen** presented the paper "**Assessing the effects of using demand parameters' estimates in inventory control**" (joint work with Leo Strijbosch and Ruud Brekelmans). The choice of the re-order point or order-up-to-level in inventory control is often based on service criteria. In order to determine a value of the corresponding decision variable we generally use an estimate of the demand distribution during lead time or lead time plus review period. Even when we know the distribution type involved (e.g. Normal, Gamma etc) it is not easy to determine the values by which the unknown parameters should be substituted to get a performance that is close to the desired one. This research investigates the effect of using sample statistics and several corrections on the performance of the inventory control model. In particular it examines how close the required service level is attained under the various approaches. Simulation is conducted on theoretically generated data and the results are very encouraging indeed, showing that the corrections under concern improve the attained service level.

Aris Syntetos

FI5 – Friday morning, August 25

The session was very well attended with more than 20 conference participants present. The session consisted of two presentations.

The first presenter was **Ashish Chandra** from Mott MacDonald, UK and he discussed strategic inventory management for the textile industry with a special focus on forecasting demand using a customer retention model. This was based on research in collaboration with Gaurav Kapoor from Triple Point Technologies, India. In this research, they look at multi-product manufacturers working in the upstream of textile industry value chains. These firms face the challenge of estimating demand for slow-moving capital goods. Instead of the usual inventory focus on transportation and warehousing cost, this study aims to attain higher logistical efficiency by finding a suitable forecasting model for mapping customer satisfaction to demand using a disaggregate customer retention model. The model is tested empirically for an established manufacturer of specialty high-value nylon and polyester products in India.

Munneori Kajiwara gave the second presentation based on a study with Masaru Tezuka, Kazunori Miyabayashi and Takayuki Matsune, all from Hitachi East Japan Solutions Ltd., Japan. He proposed a systematic approach for utilizing uncertainty management in the forecasting process. For Hitachi East Japan Solutions Ltd., this has lead to:
(1) Better understanding of demand and forecasting performance,
(2) Better use of forecasting results to adjust the inventory control policy.
(3) Aligning business processes and rules
(4) Implementing forecasting methods and information technology tools, and
(5) Increased knowledge on the impact of quantitative analysis, scientific decision making, and the effectiveness of simulation.

Ruud Teunter

Section 3: Mathematical Modelling

MM1 – Tuesday morning, August 22

This session started at 9:00 pm and it included three presentations. The first two papers introduced new inventory models and the third one studied the bullwhip effect in supply chains. All papers presented quantitative models. There were about 20 participants during the section.

In the first paper, "**Risk Preference and Robust Inventory Decisions**" by **Werner Jammernegg** and **Peter Kischka**, the authors made an extension of the Newsboy model and took into consideration of the risk attitude of decision makers. By examining stochastic dominances and using maximin and minimax regret, the authors claimed that a robust decision can be obtained. Interesting issues, such as how to obtain the weighting factor, was discussed.

The second paper, "*Fuzzy Perishable Inventory Problem with a Piecewise Linear Ordering Cost*" was authored and presented by **Hiroaki Ishii**. Compared with other inventory models, the major difference in this paper is that shortage cost is considered to be fuzzy. Theorems have been developed regarding the convexity of the objective function and conditions for optimality. To respond to the audience's question, Professor Ishii also discussed the advantages and differences between fuzzy and conventional probability approaches in inventory modelling.

The last paper, "Contingency Between Elasticity of Demand and Bullwhip Effect in Logistics Chain" is authored by **Francisco Campuzano Bolarin, Marija Bogataj, Ludvik Bogataj,** and **Lorenzo Ros McDonnell**. The authors claimed that demand elasticity should be considered in examining the bullwhip effect. A comparison study was conducted to show the difference between the conventional variance approach and their new approach. This study was based on system dynamics methodology and VENSIM was used for numerical examples. During the discussion, the audience quested about how to managing the transient period in simulation when demand is not stable.

Ou Tang

MM2 – Tuesday afternoon, August 22

The session included two presentations that both analysed new replenishment policies for periodic review tic inventory models. **Chi Chiang** (National Chiao Tung University, Taiwan, R.O.C.) presented his paper "**A new periodic review replenishment policy**" where inventory is reviewed every n periods and an order is placed to increase the inventory position to an order-up-to-level. The items are preferably shipped in n shipments of given size in every period. To account for demand variability, the initial order is increased in case of larger previous demands and the first shipments are decreased or cancelled in case of smaller demands. The presentation gave an overview on properties of the optimal policy parameters and presented an average cost analysis to determine the optimal parameter values for the review interval, the order-up-to-level and the shipment size.

Numerical examples illustrated the impact of different parameters on the optimal policy.

Gudrun Kiesmüller (Technische Universiteit Eindhoven, The Netherlands) in her paper "**A multi-item periodic replenishment policy with full truckloads**" analysed a multi-product replenishment problem of a retailer with joint transportation costs and a positive lead time from a supplier. To coordinate the replenishments, dynamic order-up-to-levels are proposed that fill trucks or postpone replenishments to achieve economies of scale. The performance of the method is compared to a lower bound and to an uncoordinated policy in a numerical study to illustrate the benefits of the full truckload policy. The study illustrates a substantial cost saving potential by a dynamic coordination of replenishments.

Stefan Minner

MM3 – Thursday morning, August 24

Three papers were presented and widely discussed at the Mathematical Modeling Session, MM3. About 25 people attended this morning session, although it was the first session after the whole day excursion on Wednesday.

Beatriz Abdul–Jalbar, Universidad de La Laguna, Tenerife, Spain presented the first paper entitled "**A New Heuristic to Solve the One-Warehouse N-Retailer Problem**" (co – authored by Anders Segerstedt, Luleå University of Technology, Sweden, Joaquín Sicilia-Rodriguez, Universidad de La Laguna, Tenerife, Spain and Andreas Nilsson Luleå University of Technology, Sweden).

They have considered a multi-echelon inventory system in which one warehouse supplies an item to multiple retailers. Customer demand arrives at each retailer at a constant rate. The retailers replenish their inventories from the warehouse which in turn orders from an outside supplier. It is assumed that shortages are not allowed and lead times are negligible. Although these distribution/inventory systems are encountered frequently in practice and have been extensively analyzed in the literature, the form of the optimal replenishment policy is very complex.
A new heuristic to compute effective policies by finding the balance between the replenishment and the inventory holding costs at each installation is devel-

oped. The proposed heuristic can be easily implemented in practice since it may be incorporated in any spreadsheet application, providing efficient solutions. An extensive computational study indicates performance superiority of the proposed method compared with other existing procedures.

Stefan Minner, University of Mannheim, Germany, presented the second paper entitled "**A Comparison of Heuristics for the Multi-Product Dynamic Demand Inventory Problem with Limited Warehouse Capacity**".

This work studies the problem of the replenishment of multiple products to satisfy dynamic demands when the warehouse capacity or the available budget for inventories is limited. The problem is modelled as a discrete time, finite horizon planning problem with setup costs for each single replenishment and linear inventory holding costs. Backorders are not permitted and replenishment lead times are assumed to be negligible. The objective is to minimize total cost over the entire planning horizon and across all products.

Different Mixed-Integer-Programming formulations for the problem are presented. An alternative formulation on the basis of demand fractions replenished in a certain period is also presented, providing smaller gaps when solving problem instances using commercial solver packages. Exact solutions and

lower bounds obtained by Mixed-Integer-Linear-Programming serve as benchmarks for different problem-specific heuristic solution principles that are compared in a numerical experiment.

Three new heuristics are proposed. The first one is a forward algorithm that successively builds lots by extending replenishments according to a cost-based priority rule. The second heuristic solves the lot-sizing problems independently for each product in a first step and then resolves capacity violations by a push/pull mechanism. The third method successively improves an initial lot-for-lot schedule by combining replenishments according to a savings-based priority rule.

Based on a test set with constant, varying with regular, sporadic, and seasonal demand patterns, different setup and holding cost ratios, and different degrees of capacity constraints the results indicate that the average cost performance of the savings based improvement method performs better staggering solutions compared to the constructive method and the feasibility push/pull heuristic.

Ou Tang, Linköping Institute of Technology, Sweden, presented the third paper entitled "**Heuristics for the Economic Lot Scheduling Problem with Returns**"

(co–authored by Ruud Teunter and Konstantinos Kaparis from Lancaster University, UK).

Motivated by a case study of a company that produces car parts, the authors study the multi-product economic lot scheduling problem for a hybrid production line with manufacturing of new products and remanufacturing of returned products. Both the cases with a single production line for both manufacturing and remanufacturing operations, and the case with dedicated production lines are considered. For this problem, policies with a common cycle time for all products, and with one manufacturing lot and one remanufacturing lot for each product during a cycle are considered. The objective is to find the best policy with a common cycle time for all items, and with one manufacturing lot and one remanufacturing lot for each item during a cycle. For both cases, (i) an exact algorithm is presented based on a mixed integer linear programming (MIP) formulation of the problem for a fixed cycle time, and (ii) simple heuristics are proposed and their performance is tested in an extensive numerical investigation. A comparison between the two cases is also presented.

Ioannis Ganas

MM4 – Thursday morning, August 24

E. van der Sluis: Some Experiments with the Economic Lot Scheduling Problem
Erik van der Sluis focused on the economic lot scheduling problem dealing with how to schedule several items on a single facility. He presented a two-step procedure for finding a feasible cyclic schedule. The first step aims at finding a (possible infeasible) cyclic schedule by a sequential approach, starting with the item for which the cycle time (determined by the Economic Production Quantity) is largest. Based on the cyclic schedule found in the first step, the second step translates the feasibility test into a single-machine scheduling problem with release dates, due dates and processing for each batch, such that the completion times are equally spaced. This problem can be solved rather easily using a MIP model.

K. Skouri, I. Konstantaras, S. Papachristos and I. Ganas: An Order Level Inventory System with Ramp Type Demand Rate, Partial Backlogging and Weibull Deterioration Rate
Konstantina Skouri derived the optimal replenishment policy over a finite planning horizon of a model for deteriorating items. She assumed that

the demand rate increases with time up to a certain time, from which it becomes constant, and argued that such a demand pattern is typical when a new brand of consumer goods enters the market.
The determination of the optimal lot size is equivalent to finding the time point where the inventory level reaches zero. She proved that this time point is independent of the demand rate, which coincides with the fact that the same result is valid in many order-level inventory models.

K. Matsuyama, T. Sumita and D. Wakayama: Inventory Policy which Maintains Inventory Level.
Keisuke Matsuyama focused on maintaining a predetermined inventory level in a periodic-review setting. He investigated two feedback models, called proportional and differential, and two demand forecast models, called simple and finer. The demand in the near future is forecasted roughly by the simple forecast model and then he concluded that the role of feedback is great, which is in contrast to the small effect of feedback with the finer forecast model.

Søren Glud Johansen

MM5 – Thursday afternoon, August 24

In this session three promising papers were presented about spare part problems.

The first presentation was "**Evaluation of a multi-item inventory system with coupled arrivals and returns**" presented by **I M H Vliegen** and with co-author **Geert Jan van Houtum.** The paper deals with the analysis of a single-location, multi-item inventory model for service tools, in which coupled arrivals and coupled returns occur. When a "machine" fails, not only spare parts are required also service engineers and special service tools; and often also several different service tools for the same failure, which explains "coupled arrivals". They study fill-rates; requested tools that are not on stock are delivered via an emergency channel and considered as lost sales. They develop two approximations for the order fill-rates, which are both based on Markovian models. One approximation underestimates, and one overestimates the fill-rate, the one that overestimates are reasonably accurate and can be computed efficiently.

The second presentation was "**Joint optimisation of spare part inventory, maintenance frequency and repair capacity for k-out-of-N systems**" presented by **Karin S. de Smidt-Destombes** with co-authors

Matthieu C. van der Heijden and Aart van Harten. They present a heuristic method to find a cost effective balance between maintenance frequencies, spare part inventories and repair capacity in order to achieve a target availability level. Just extending the METRIC approach yields inferior results. The heuristic shows very small cost increase compared to total enumeration, with a computation time in seconds compared to enumeration in days.

The third presentation was "**Inventory Control of spare parts after EOP (end of production)**" presented by **Rainer Kleber** and co-author **Karl Inderfurth**. They present a new heuristic approach, where the planning period is split in a first period where primary source is final order and for second period primary source is remanufacturing. Run-out time of final order is set deterministically, final order and remanufacturing up to levels are treated "newsvendor problem"-like. The model requires knowledge about future demand and return developments; they indicate it is a promising heuristic approach for determining final order in the presence of product recovery.

Anders Segerstedt

MM6 – Thursday afternoon, August 24

B. Abdul-Jalbar Betancor – J.M. Gutiérrez – J. Sicilia-Rodriguez: A Two-Echelon Inventory / Distribution System with Power Demand Pattern and Backorders

Beatriz Abdul-Jalbar from the Universidad de La Laguna presented the first paper, which addresses the implications of considering power demand pattern and backorders in the one-warehouse N-retailer problem. In this case, obtaining the total average cost is an arduous task. However, applying single-cycle policies facilitates the computation of the total average cost. Under these assumptions, they develop a heuristic procedure to obtain near-optimal single cycle policies that minimize the total cost of the system.

Based on the average total cost given already determined order frequencies for some retailers, the optimal order frequency for the next retailer is calculated. In this sequential and heuristic way, they are able to compute single-cycle policies effectively.

Computational experiments showed on average only very small gaps between the cost of the heuristic policy and a lower bound on the cost of an optimal policy.

S.G. Johansen – A. Thorstenson: Value-Based Q(s, S) Policy for Joint Replenishments

The second paper was presented by Anders Thorstenson from the Aarhus School of Business. The authors proposed a new replenishment strategy for the joint replenishment problem with stochastic demands generated by Poisson processes, backordering, constant lead times and a standard cost structure. Under a Q(s, S) policy, item inventories are only reviewed when the total demand of all items since the last replenishment has reached the level Q. In that case, the standard (s, S) policy is applied for each item.

In the value-based Q(s, S) policy, item inventories are reviewed earlier, i.e. when total demand of all

items since the last replenishment is close to Q. Expected costs are calculated for ordering immediately and for deferring the order until the level Q is reached. The calculations require relative values from a Markov chain and are computed by a value iteration algorithm. By considering the number of replenishment cycles since the items were last ordered, the size of the state space was considerably reduced. Computational experiments showed that using the value-based Q(s, S) policy, the long-run average cost could be further reduced compared to the optimal Q(s, S) policy.

C. Pince – E. Berk: An Inventory Model for Systems with Random Deal Offerings and Partial Backordering

The third and final paper of this session was presented by Cerag Pince from Erasmus University Rotterdam. The authors studied the effect of price discounts, which are offered at random points in time, for the systems with partial backordering. Whenever the on-hand inventory is depleted completely, a certain percentage of customers are backordered against unit and time-weighted backordering costs. The customers not backordered are lost with unit lost sales cost. Incorporation of partial backordering is generally difficult due to analytical intractability.

The authors considered a single item, single location, continuous review inventory system with constant demand, zero lead times and two types of replenishment: deal replenishment and regular list replenishment. For this system they propose an (r, R, s, Q) control policy. When a deal is offered and if the inventory level is less than s, a replenishment order from the discounted price is given to increase the inventory level up-to s + Q. In all other cases, a replenishment order is given to increase the inventory level up-to R whenever it drops to reorder point r. They derived exact closed form expressions of the optimal policy parameters and conducted a numerical study to investigate their sensitivity.

In conclusion, the session was well attended and the high level of interest from the audience was underlined by the lively discussion and many questions from the audience.

Erik van der Sluis

MM7 – Friday morning, August 25

Three papers were scheduled for the early morning session on the last day of the Symposium. This session had an audience of around 15 people. Common to all three papers was the issue of lot sizing, however, in noticeably different inventory control contexts.

Zanoni, S., Ferretti, I. and Zavanella, L.: Lot-Sizing Decisions in a Closed-Loop Supply Chain

The first paper by Zanoni, Ferretti and Zavanella, all from the University of Brescia, was presented by Simone Zanoni. The paper is concerned with a reverse logistics system designed as a hybrid system with manufacturing and remanufacturing options. Such a system contains several different stock points to be coordinated. The model is set in a deterministic framework and it is assumed that any recovered component can be considered as good as new and it may therefore be used to satisfy the same demand as a new component. The main goal of the study is to define the optimal disassembly cycle of the returned product and to determine the optimal size of the remanufacturing and manufacturing lots in this cycle.

Kovács, A., Brown, K.N. and Tarim, S.A.: An Efficient MIP Formulation for the Capacitated Lot-Sizing and Scheduling Problem with Sequence-Dependent Setups

The second presentation in this session was made by András Kovács from Cork Constraint Computation Centre, Ireland (and also associated with the Computer and Automation Research Institute, Hungary). His co-authors Brown and Tarim are affiliated with the Centre for Telecommunications Value-Chain Research, Ireland. Their paper deals with the well-known periodic, single-machine capacitated lot-sizing and scheduling problem. In particular, in this paper setup times and costs are sequence-dependent and setups are allowed to carry over to the next period. A novel MIP formulation is suggested based on generating in a pre-processing step all efficient item sequences in a given time period. Compared to earlier computational results, the approach presented is capable of solving significantly larger problems.

Transchel, S. and Minner, S.: **Dynamic Pricing and Replenishment in the Warehouse Scheduling Problem**

The last paper in this morning session was presented by Sandra Transchel who, like her co-author Stefan Minner, is affiliated with the University of Mannheim. Their paper analyzes the effects in a multi-item setting of jointly considering the operationally oriented warehouse scheduling problem and the marketing-oriented pricing problem. The objective is to maximize the total long-run average profit by choosing the lot sizes, the sequence of order releases in a pure rotation cycle, and the pricing policy. Two pricing strategies are considered: a static strategy with constant selling price and a dynamic strategy in which price is adjusted continuously. Structural properties of optimal policies as well as numerical results for the static and dynamic pricing strategies were presented.

Anders Thorstenson

MM8 – Friday morning, August 25

J. Marklund, Lund University (joint paper with K. Rosling, Växjö University): Asymptotically Optimal Supply Chain Stock Allocation

This paper concerns a one-warehouse-N-retailer problem with periodic review and stochastic demand. The retailers can order in each period and the warehouse every m-th period. The retailers can vary their order-up-to-levels over time. The authors derive an approximate policy, which is asymptotically optimal as the number of retailers N → ∞. They also provide a near optimal policy for small values of N. A basic idea is to use Lagrangean relaxation of the constraint coupling the N retailers. The solution means that the retailers use order-up-to-levels that are decreasing over the warehouse cycle.

A. Slepchenko, Erasmus University: Optimization of Dynamic Repair Priorities in Spare Parts Supply Systems

A single-location spare part supply system is considered. A failed part is, if possible, replaced from stock and sent to repair. The repair shop can handle different types of spares. The problem considered concerns the dynamic optimization of processing priorities for different types of spare parts. It is shown how the optimization can be carried out. Several heuristics are also considered.

C. Larsen, Århus School of Business: The Q(s, S) Policy for the Joint Replenishment Problem Extended to the Case of Correlation among Item-Demands

A joint replenishment problem with K items is considered. The demands for different items are correlated. The customers arrive according to a Poisson process. When a customer demand occurs, the demands for different items are specified by a K dimensional vector with a given probability distribution. A so-called Q(s, S) ordering policy is evaluated and optimized. When the accumulated aggregate demand since the last replenishment possibility is greater than or equal to Q, item specific (s, S) policies are applied for each item. It is shown that negative correlation means that the considered policy works less well compared to positive correlation.

Sven Axsäter

MM9 – Friday morning, August 25

An important progress in inventory and production planning is the consideration of the supply chain concept. The two papers presented in this section expanded previous models into this direction.

The first paper presented by **B. Selcuk** (**Supply Chain Operations Planning With Load Dependent Lead Times,** co-outhored by J J.C. Fransoo and A.G. de Kok) provides insights into the effectiveness of adapting lead times of a supply chain in a hierarchical planning context using the clearing function concept. It models a multi-period multi-item order release and scheduling problem such that the delivery schedule of the orders are determined through the planned lead times.

The supply chain is decomposed into several self contained production units; each production unit is

responsible for the production of a specific set of products from a specific set of materials and components. The overall decision making process is decomposed into two levels, namely aggregate-level planning and detailed-level planning. Material co-ordination decisions regarding the release of production orders and their delivery schedule (due to the planed lead times) are given by the aggregate-level planning. Capacity loading decisions are decomposed from order release decisions. The periodic releases of WIP into the shop provide a means to plan the actual completion times of orders under capacity considerations. The detailed-level planning provides the execution decisions (scheduling and sequencing of the authorized orders) yielding the actual delivery performance.

Experimentations with various supply chain settings are performed. The results indicate that, in conjunction with the concept of clearing limited update of the lead times provides the flexibility under fluctuating demand conditions and generate less costly solutions, but at the same time increases the nervousness in the planning system.

The second paper of **S. Bylka** (**Competitive Strategies for a Production Distribution System)** considers a decentralized dynamic production - distribution control. A discrete deterministic model in which a vendor produces a product and supplies it to the buyer is considered.

Several papers on vendor--buyer integrated production inventory management assume that policies are set by a central decision maker to optimize total system performance. Although vendor and buyer may agree to minimize the total cost, at least one of them has a private incentive to deviate from the agreement. In the competitive situation, the objective is to determine schedules which minimize the individual average total cost of production, shipment and stockholding. Therefore, especially in the case without prices, an additional problem arises how to divide shipment costs between the agents.

The division of shipment costs is assumed central coordination or negotiation initially. It leads to a class of non--cooperative games, indexed by two parameters connected with partitions of shipment costs. In each game, the vendor and buyer independently choose strategies to minimize their costs. The games differ in competitive regime -- in classes of admissible policies. Competitive policies are investigated as feasible strategies in a conditional noncooperative game. Some properties of equilibrium strategies are investigated as acceptable equilibrium strategies of subgames in the game.

Both presentations were followed by some minor comments.

Peter Kelle

Special Workshops

WS1 - Tuesday afternoon, August 22

Education Hubs on the Horizon - Lessons from Logistics Experience
by József Berács, Corvinus University of Budapest, Hungary

Professor József Berács is a professor in Marketing and the Director of the International Studies Center of Corvinus University of Budapest, Hungary. In his contribution he presented a highly interesting view on the developments of higher education in the decades to come, and the changes that we have already witnessed. He draws parallels with logistic developments, in particular he explains that services like higher education can be produced in different points in time and can be inventoried. Education will be much more demand or market oriented (push

instead of pull). The author signals a parallel between global logistics and economic hub on the one hand, and global higher education hubs on the other hand. As an example of the latter, a discussion of the Dubai Knowledge village served as a starting point.

Dubai as the center of the United Arab Emirates created a vision on how to change he traditional "Oil & Gas" economy towards a Knowledge Economy. The Dubai Knowledge Village (DKV) is located in the Dubai Technology and Media Free Trade Zone what offers place for 700 international ICT companies, including Microsoft, IBM, Cisco, hiring 14 000 knowledge workers. In addition to this 850 media companies (CNN, Reuters, etc.) employ 15 000

knowledge workers. In the 2004/2005 academic year there were 6000 students studying in DKV. 15 international universities from 9 countries offer bachelor and master degrees for local and foreign students. By 2010 DKV plans to have 50 000 students sourced from outside of Dubai studying at the cluster.

During the presentation and subsequent discussion more general issues and questions were raised, basically connected with the rapidly increasing internationalization in higher education. The changing situation in China is one example, currently still many Chinese students study abroad but the number of universities and HEI's in China is rapidly growing, while many foreign scientists are hired to increase also academic levels. Questions related to

the prevention of Brain Drain were discussed. The emerge of other teaching practices (Electronic Learning Environments) and the increase of Long Life Learning concepts (in terms of marketing: new target groups) are changing the landscape as well. Also the advantages and disadvantages of on-line or distance learning were raised (no traveling, no socialization which is still an important cultural aspect of internationalization). No very specific conclusions were drawn, apart from the fact that many countries should rethink their competitiveness in higher education (where an interesting parallel with Michael Porter's discussion on economic competitiveness of nations was drawn). Lessons for the program structure in Hungary should be drawn as well.

Henk Zijm

WS2 – Tuesday afternoon, August 22

Some Ideas on Enhancing Research Productivity By Edward A. Silver

In this workshop, Ed Silver distilled his experience, observations and insights into a series of suggestions on how to improve output of high quality research. His ideas come out of his distinguished career of more than 40 years consulting, teaching and mentoring PhD and Post-Doc students. His topics ranged from how to generate quality research ideas and being smart about publishing PhD dissertation research to working with colleagues and preparing articles for publication. One theme that came through clearly was the need for discipline, organization and persistence in the approach. For example, at one point, we were shown an article outline that was cross-referenced to Ed's detailed "idea file." Since Ed will make his remarks available to the ISIR community, I won't detail them here but will describe a bit the session itself instead.

The workshop was informal and discussion was encouraged – although that seems redundant with a group of ISIR members. Indeed there was interaction throughout the session. Many of the comments from the audience confirmed Ed's suggestions by giving personal examples and/or offering variations. Some of the remarks by the attendees extended the conversation to the realm of discussant's roles at professional meetings (a topic of interest for future

symposia) and dealing with reviewer's comments. Most of the interaction simply reinforced the quality of Ed's suggestions and underscored the importance of discipline.

Quoting from such sources as Vincent R. Ruggiero's "Art of Thinking" (Harper Collins, 1995) and Ronald R. Berk's "Professors Are from Mars Students Are from Snickers" (Mendota Press, 1998), Ed extended his ideas to creative thinking in general and teaching in particular. The audience picked up the teaching theme and several of the closing remarks concerned the relationship between research and teaching, and creativity in the classroom. Overall the session was very much appreciated by the audience and it was well attended.

D. Clay Whybark

WS3 – Tuesday afternoon, August 22

Bullwhip Effect: Concept, implications and responses
By N. Ravichandran

The purpose of his lectures was to introduce the concept of Bullwhip effect in the context of supply chain and later to present the examples based on real life experiences where the Bullwhip effect in supply chain is considerably reduced. The examples are related to the industry in India. It is well known that Enterprise Resource Planning and Vendor Managed Inventory are good tools to reduce the Bullwhip Effect. Some modification of the classical inventory control policies to eliminate Bullwhip Effect can be also used. He argued that managing Bullwhip Effect is a strategic initiative by organization. He was talking about the value of centralized demand information and information sharing on inventory in a supply chain. During his lectures we have been informed about the cases of industry in India where Bullwhip Effect has been constrained substantially by coordination of various elements of the supply chain.

Marija Bogataj

WS4 – Tuesday afternoon, August 22

The Tuesday Evening Session (WS 4) included a presentation entitled "**International Logistics Management Game "Edutainement" in the Hungarian Higher Education"**. This presentation concerned experiences from running the International Logistics Management Game (ILMG) in the Corvinus University, Budapest, and was reported by Zsofia Szujo and Agnes Szarka. Also present was the third co-author Istvan Jenei. This management game has been developed during a long period of time with partners from around a dozen European universities. Apart from vocational training, it has been run, in particular, in Linköping, Frankfurt (O), Cartagena, Brescia, Riga, Ljubljana and Budapest.

The ILMG Game is computer-based and runs in continuous time, using internet communication between a server and a number of clients representing "corporations". These corporations are simulated companies competing with different products in different markets. The corporations establish corporate units (which may have different functions) in one or more regions. Some units may be production plants, others may be specialised in selling products. Products may be transported between the regions in different transportation modes. Each corporation is represented by a team having access to one or several internet terminals. The main program system (Game Control Centre) is located on a server possibly at a far distance from the corporations. From this server the Game Management operates the Game. The Game Management sets an environment for the Game by deciding on a number of basic issues, such as the number of regions available and their names and several other characteristics concerning available products, technical coefficients, regional characteristics, business cycle development, etc. It also decides on the initial characteristics of an individual corporation joining the Game. Once started, the corporations take decisions of different kinds concerning investments, production, marketing, transportation, and several other issues. The joint consequences of these decisions are determined by processing this information in the Game Control Centre, which operates continuously. The results of the decisions of corporations are displayed in a number of different realistic reports, such as balance sheets, sales reports, material flow reports, etc.

The presentation focused on reporting experiences of the Game's ability to develop creativity, problem-solving and decision-making abilities, human relations and initiative skills of the participating students in an "edutainement" environment (based on the principle of "learning while having fun"). The experience from some students was that the Game was too complicated, while others wanted to have more complex product structures, also encompassing "make or buy" problems. Also was requested a manual written in Hungarian to explain terms and concepts. The overall conclusions were very positive, such as ILMG making logistics education more valuable and effective, the time of the Game should be increased, it should be incorporated into the Bologna process and should also be made part of the MBA programme of the university.

Robert W. Grubbström

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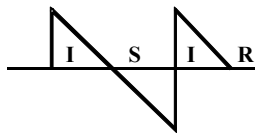
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CONFERENCE ANNOUNCEMENTS

12th MSOM Conference & Annual INFORMS Meeting
June 18-19, 2007, Beijing, China

The 12th MSOM conference, the annual meeting of the INFORMS Society on Manufacturing and Service Operations Management, will be held at theTsinghua University Campus in Beijing. The MSOM Conference is open to all researchers and practitioners with an interest in the management of manufacturing and service operations. It will be preceded by the Multi-Echelon Inventory Conference, a one-day conference bringing together practitioners and researchers interested in multi and single-stage production-inventory operations, supply chain management, and logistics. The Multi-Echelon Inventory Conference 2007 will take place on Sunday, June 17, 2007 at the same location.

Conference topics include but not limited to:
- Supply chain management
- Management of service operations
- Production planning & scheduling
- Manufacturing strategy & flexibility
- Field studies in operations
- Process & quality improvement
- Purchasing & auctions
- Outsourcing
- Inventory models
- Coordination issues
- International operations

Important Dates:
- Submission deadline: **February 1**
- Early registration: **April 1 – May 1**
- Last day of the registration: **June 1**
- Multi-echelon Inventory Conference: **June 17**

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DECISION SCIENCES INSTITUTE INTERNATIONAL MEETING
July 11-15, 2007, Bangkok, Thailand

The 9th Decision Sciences Institute International Meeting, in conjunction with the 12th Annual Meeting of the Asia Pacific Region will be held July 11-15, 2007, in Bangkok, Thailand.

Submission deadline is March 30, 2007.
Contact Program Chair Somboonwan Satyarakwit, Dhurakijpundit University, 110/1-4 Prachachuen Road , Lak Si, Bangkok 10210, THAILAND, (662) 954-7300, fax: (662) 954-7910, sboonwan@dpu.ac.th

http://interdsi2007.nida.ac.th/index.html
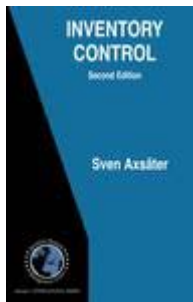
INVENTORY CONTROL

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Axsäter, Sven
2nd ed., 2006, XVI, 336 p., 47 illus., Hardcover
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The strategic importance of efficient Supply Chain Management is today fully recognized by top management. The total investment in inventories is enormous, and the control of capital tied up in raw material, work-in-progress, and finished goods offers an important potential for improvement. At the same time, advances in information technology have drastically changed the possibilities to apply improved inventory control techniques. Furthermore, the recent progress in research has resulted in new and more general methods that can reduce the supply chain costs substantially. Scientific methods for production and inventory control can give a significant competitive advantage. INVENTORY CONTROL deals with a range of different approaches and models that can be used when developing inventory management systems and practices.

The book's primary purpose is to serve as a core textbook in various university courses. In addition, it serves as a source book to industry practitioners to understand inventory control techniques and thereby simplify and promote implementation in practice. It covers traditional approaches for forecasting, lot sizing, determination of safety stocks and reorder points, KANBAN policies, and Material Requirements Planning. But it also includes very recent advances in inventory theory, for example, new techniques for multi-echelon inventory systems and Roundy's 98 percent approximation. The book also considers methods for coordinated replenishments of different items, and various practical issues in connection with industrial implementation.

The second edition includes: alternative forecasting techniques, more material on different stochastic demand processes and how they can be fitted to empirical data, generalized treatment of single-echelon periodic review systems, capacity constrained lot sizing, short sections on lateral trans-shipments and on remanufacturing, coordination and contracts.

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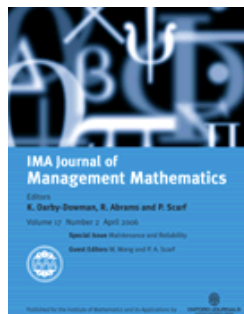
IMA Journal of Management Mathematics

Special Issue on Demand Forecasting for Inventory Management

Special issue editors

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Brief description of the topic

Many inventory systems cater for uncertain demand. The inventory parameters in these systems require estimates of the demand and forecast error distributions. The two stages of these systems, forecasting and stock control, are often examined independently. Most studies tend to look at demand forecasting as if this were an end in itself, or at stock control models as if there were no preceding stages of computation. Nevertheless, it is important to understand the interaction between demand forecasting and inventory control since this influences the performance of the inventory system.

Papers are invited for a special issue on "Demand Forecasting for Inventory Management" of the *IMA Journal of Management Mathematics*. Theoretical and/or empirical contributions that consider the interface between demand forecasting and inventory management and make a significant contribution to the field will be considered for publication. Potential topics include, but are not limited to:

- **Accuracy and performance measures**
- **Bullwhip effect**
- **Case studies**
- **Demand categorisation**
- **Distributional assumptions**
- **Hierarchical forecasting**
- **Multi echelon systems**
- **Serial systems**
- **Service level in the supply chain**

Deadlines and submission instructions

Manuscripts should be prepared in accordance with the "Instructions to Authors" presented in the Journal's web site (http://imaman.oxfordjournals.org/). Submissions should be e-mailed to both of the two Special Issue Editors. The PDF format is preferred, although the MS Word version is acceptable. The abstract of the paper should also be submitted separately in MS Word format. All papers will be refereed according to the standards of the *IMA Journal of Management Mathematics*. All submissions should be received by the Special Issue Editors by **January 12, 2007**.

Publication schedule

Manuscript submission: **January 12, 2007**
Reviewers' reports: **March 30, 2007**
Revised paper submission: **June 29, 2007**
Final manuscript submission to publisher: **December 21, 2007**
Publication: **April 2008 (vol. 19, number 2)**

Special issue editor

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