Intelligent Systems for Manufacturing in the Internet Age

by

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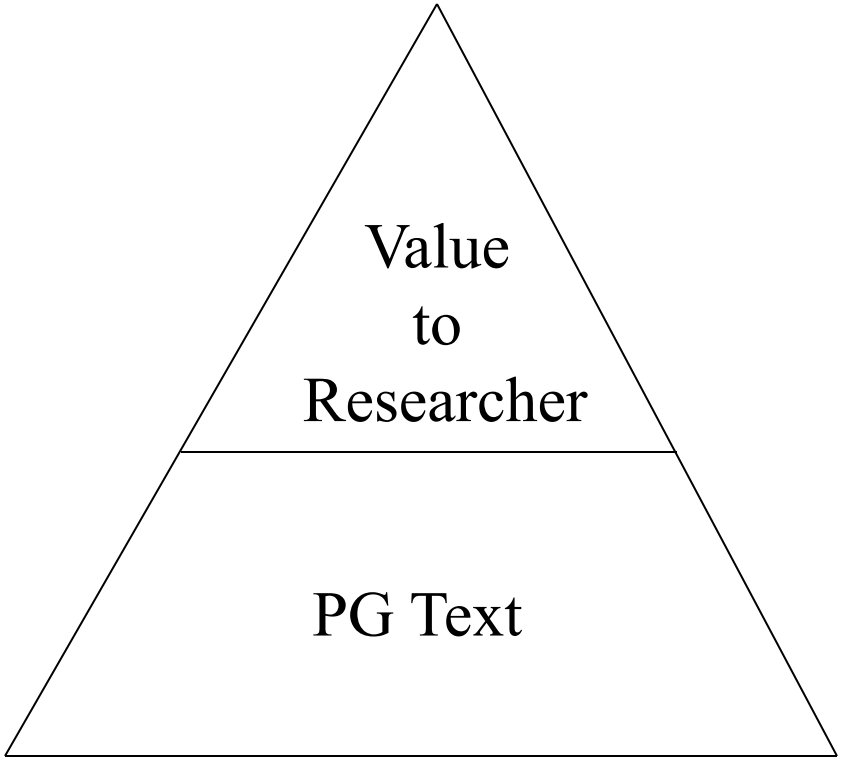
Target Readers

- Ug text: Not now
- pg text √
- researcher √
- reference/handbook: No
- monograph: No


Value
to
Researcher
PG Text

Book Title

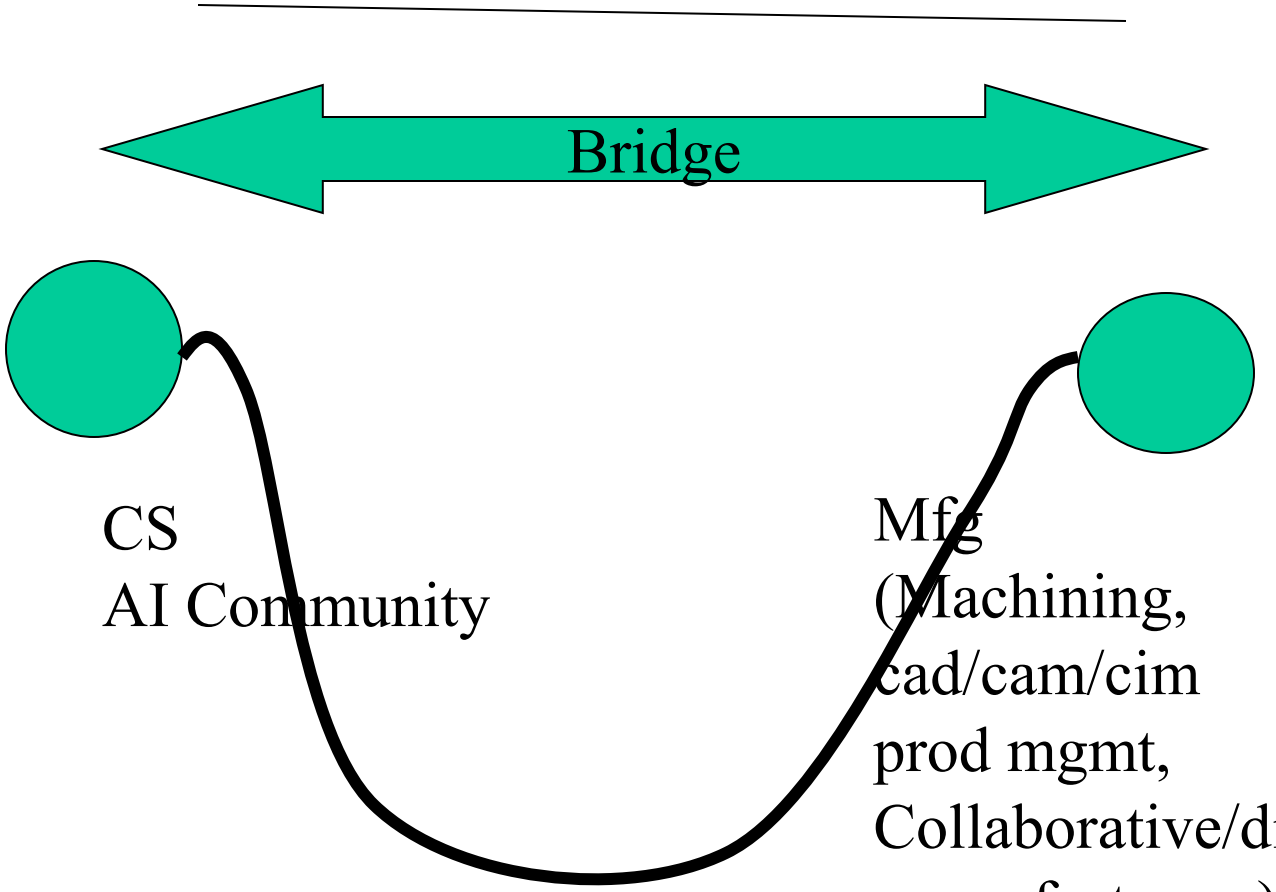
- **Intelligent Systems for Manufacturing**
- **AI in Manufacturing**
- **Intelligent Systems for Manufacturing in the Internet Age**

  (Every chapter should have an assessment/research directions of Internet based AI in mfg. It is better to avoid the term AI because the term is less used in the US and is being replaced by KDI, Cognitive Intelligence, Agent Based systems, etc.)
- **Knowledge and Distributed Intelligence in Mfg**
- **Mfg Intelligence for the Internet Age**

Where is our audience located

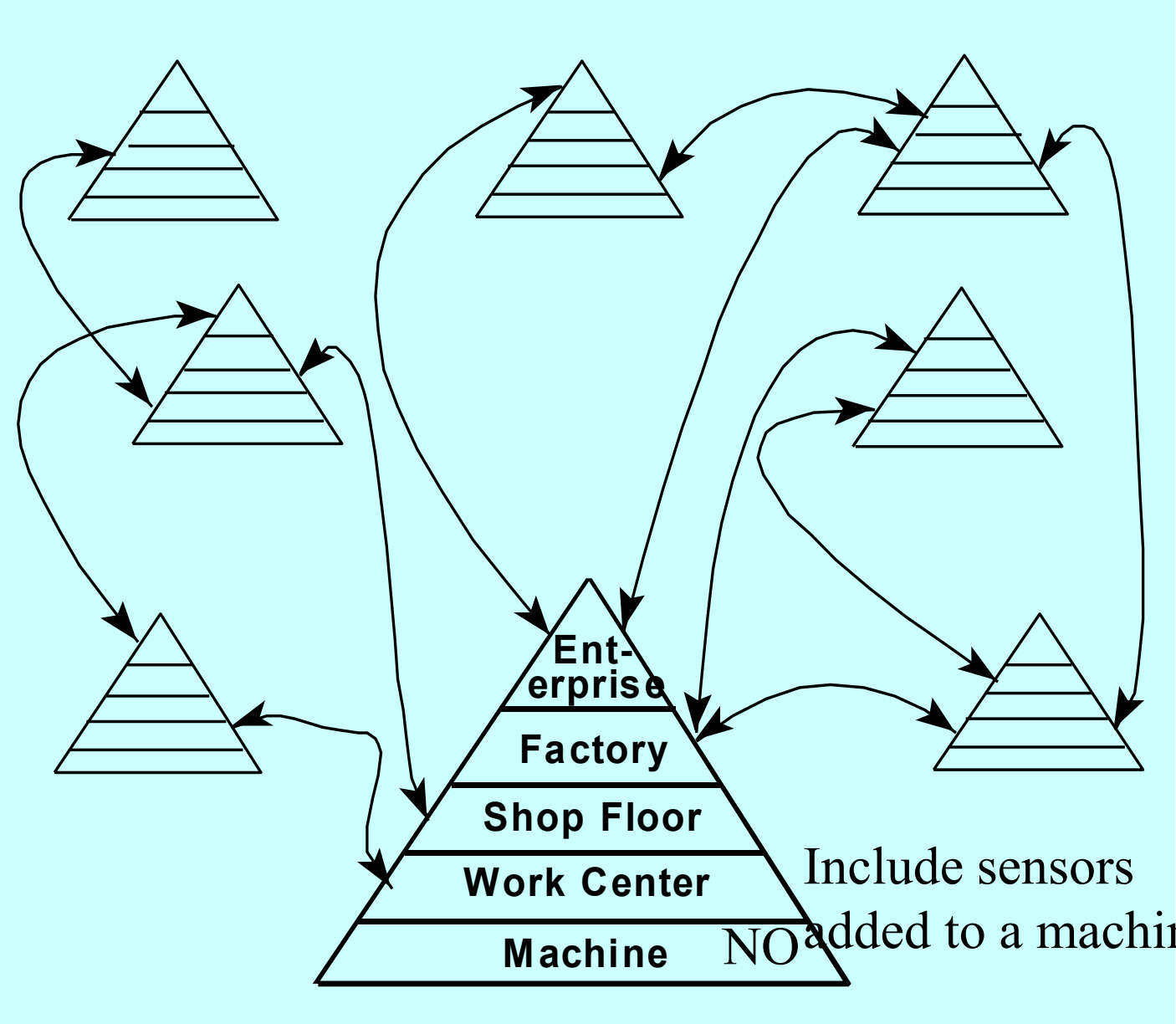
- US: Relatively small. US mfg community dominated by Sam Wu's group. Unless one of them is writing, nothing will be accepted. Much of the group's bias is towards metal cutting, milling, etc. For this group, AI and the Internet is of peripheral interest. There are some 400 ME depts, I.e. about 20,000 ME grad students. Assume an yield of 5%, i.e. 1000 students. Much work on mfg and computing in the US is done by IE groups. Therefore, much of the US audience will be from IE. There are about 100 IE depts with about 50 graduate students each. Total 5000 IE grad students. We can assume, 50% will use the book = 2500. Total 3500. of which about 50 have But, their focus is on CAD, CAPP and CIM at a system level and including Internet. Sensor level, supply chain logistics, etc. is the interest of OR group. Most AI work in CS depts in the US is done by WASPs and a minority of Indians from MIT, Stanford, Carnegie Mellon, Berkely, Yale, Brown. These Wasps said foriegners do not know English and hence can't think. Hence, probably, in the East, few CS depts have engaged in AI.

- Canada: 10% of US., = 350.
- UK/Europe.
- India: Lot of interest in Mfg. India is talking about AI as a sequel to software industry. Particularly soft computing. Not much market but people will read the book.
- China: Lot of interest in AI and Interenet: both ME and CS. Much of the research is of “Me Too” type. They will also read the book. They might actually translate without credit.
- Implications: Many people will read the book. The majority of the readers (80%) will be from ME/Mfg/IE/Systems and 20% CS/EE?IT (because of Internet). Our jargon and viewpoints should be mfg biased.Convey Internet based optimism for developing countries as expressed by Negroponte and Bill Gates. May be we can ask one such person to write a foreword. Take a world view not just a US view. Do include some references from India, China, UK, Europe both in AI and mfg. Possibly include a list of AI in mfg ceneters around the world (name of ceneter, Areas of work, contact persons with e-mail addresses).


Bridge
CS
AI Community
Mfg
(Machining,
cad/cam/cim
prod mgmt,
Collaborative/distributed
manufacture...)
90%
of readers

Scope

- S2S: Sensors to Suppliers
- work center level to distributed enterprise level
- Big M: product conception to service in the context of Internet
- Research issues: (SMCLO) Search, Monitoring and Diagnosis, Collaboration, Learning and Optimization: provide the AI knowledge needed to address these issues.
- AI constantly put in the context of IT
- Pedagogic Structure
- Part A: AI in Big M (SMCLO with pointers to Part B)
- Paer B: AI tools and techniques


Ent-
erprise
Factory
Shop Floor
Work Center
Machine
NO
Include sensors
added to a machine

- Refer to AMRF (Automated Mfg Research Facility) Model instead of the triangl. Also pull out the diagram from Kumara/Ham paper "Future of CIM and FMS".
- Issues directed towards facilitating distributed manufacture: CS concepts: Internet, Agents, distributed processing, collaboration, coordination, Info processing, Human-Computer Interface, Telecommunications, Negotiation, Auction protocols, Market based approaches

  Mfg Paradigms: Agile systems, Holonic mfg systems and Modolons (part of IMS), Agent based systems

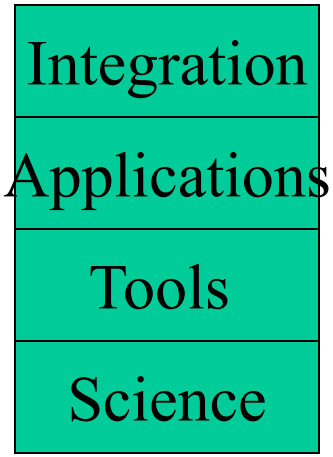
  Mfg Domains: Design, CAPP, manufacturing (scheduling, capacity planning, MRP to extended ERP, Supply Chain (Order processing, Vendor selection, production requirements planning, transportation logistics, etc.)

The various issues raised in the previous slide may be structured in terms of

- Work Center Level (sensing, monitoring, diagnostics, design, process planning,
- Shopfloor Level (scheduling, capacity planning,
- Factory Level(production planning and routing, factory layout, capacity planning, supply chain, Mfg systems design)
- Enterprise Level (customer analysis, decision support systems, Project Management, Risk Analysis

Style

- Easy, lucid but rigorous
- Bibliography (incl developing countries) at the end of the book
- AI in mfg centers
- Profuse use of figures
- Broad brush



S: Long term usefulness. Transferable
T: Transient
A: skills are transferable
I: helps move into the future

Aspect	Technician	Degree	PG
S	5%	50%	50%
T	80%	10%	10%
A	10%	25%	15%
I	0	15%	25%

Part A

(Big M Science, Ai Overview, SMCLO science, typical applications, Integration.)

1. Introduction
2. Internet in Mfg (Paul Wright's Cyber Cut)
3. Knowledge Representation
4 Search
5. Monitoring and Diagnostics
6. Coordination
7. Learning
8. Optimization

Part B

Tools, Science behind, Local Applications, Some integration of tools with other tools.

1. Foundations of Signal Processing (FT, WT, hint of fractals)
2. Fuzzy Logic
3. Finite State Machines
4. KB Systems (Expert Systems, CBR)
5 Neural Networks.
6 GA (Evolutionary Computing)
7 Software Agents
8. Other Tools: Chaos, DNA Computing, Quantum Computing

A3: Knowledge Representation

- Sub-symbolic (NN, FFT, Wavelets)
- Symbolic (Logic)
- Geometry Representation

A7: Learning

- What is learning?: All learning is inductive.
- Types of Learning: Statistical (Bayesian, Cluster Analysis, Deterministic), Logical (inductive learning), Cognitive aspects,
- Historical Perspective (structured in terms of each type)
- Statistical Learning
- Logical Learning
- Cognitive Aspects
- Distributed systems and learning
- Manufacturing Case Studies

  - General scenario in manufacturing

- Cutting Tool Failure Estimation (Describe the problem, Summarize important basic contributions, Critique, One representative current solution methodology, typical results, critique, Suggestions for future work.: Kumara)
- Adaptive Control of Machine Tools (Yung Shin)
- CBR for Product Design (from literature)
- Reactive Learning for Shop Floor Scheduling (Yeh, Paul Wright)
- Learning with regard to some aspect of supply chain logistics (?) Data mining in the internet could be the focus

What is learning?: All learning is inductive.
Connected to NNs
Types of Learning: Statistical (Bayesian, Cluster Analysis, Deterministic), Logical (inductive learning), Cognitive aspects,

Logical and Cognitive will be connected to KB Systems
Historical Perspective (structured in terms of each type)
Statistical Learning
Logical Learning
Cognitive Aspects
Manufacturing Case Studies (will be connected to monitoring and diagnosis)

- General scenario in manufacturing

‘Groups’ Bhoota Shanti

- Sam Wu (Pandit, Jun Ni, Yung Shin, Ulsoy, Dornfeld)
- CIRP (Tlusty, Merchant, Ham, Eversheim, Konig, Warnecke, Spur, Armarego, van Brussels, Kals, van Houten, Kimura, Wiendahl, Duffie, Katz)
- ‘Agile’ Group (Nagel,)
- Purdue (Ted Chang, RicK Wysk, Solberg. Kashyap)
- U of I: Shiv Kapur, DeVor,
- Canadian: Elebestawi, Altintas, D’Souza,
- Do include some Indian, Chinese, HK, Singapore, and Australian references
- Appendix: List of sites round the world where Intelligent Systems in Mfg is being carried out.

References

- [Gates 1995] Bill Gates, The Road Ahead, Penguin Books, 1995. (Available with Venu)
- [Hubbard 1996] Barbara Burke Hubbard, The World According to Wavelets: The Story of a Mathematical Technique in the Making, A.K . Peters, Wellesley, Massachusetts, 1996. (CityU QA403.3 .H83 1996)
- [Rembold 1993] Remobold, U., Nnaji, B.O., and Storr, A., Computer Integrated Manufacturing and Engineering, Addison Wesley Publishing Company, 1993. (CityU TS155.6.R458 1993)
- Venuvinod, Patri K., 1999, "Intelligent Production Machines: Benefiting from Synergy amongst Modelling, Sensing and Learning," Chapter 7, Intelligent Machines: Myths and Realities, Edited by Clarence W. de Silva, CRC Press, New York, 2000, pp. 207-243.