Data and Mathematical Model 
Interoperability: 
Applications in Manufacturing Systems 

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Manufacturing Systems Engineering

Objectives

- Systems design
- Real-time control
  - Process control
  - Scheduling — response to events
Choose

- the processing machines,
- process parameters,
- inspection devices,
- material handling equipment, etc.

*to meet target values of performance objectives,*

- production rate,
- lead time, etc.

*at minimal cost.*
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Propose Design $D_0$
$n = 0$

Propose Design $D_n$
$P_n = P(D_n)$

Evaluate Design $D_n$

Modify design as a function of past designs and performance.
$D_{n+1} = D(D_0, D_1, ..., D_n, P_0, P_1, ..., P_n)$

Is performance satisfactory?

Yes
Quit

No
Parameters needed for design:

- capital cost
- inventory holding cost
- operation times
- MTTF, MTTR
- quality behavior (e.g., yield)
- setup times
- etc.
Respond to random events and anticipated process drift *in real time* to deliver the required product at the specified time with specified quality at minimal cost.
Data needed for real-time control (data *from* the factory):

- Machine operational status (operational, under repair, blocked, starved, setup, etc.)
- Machine usage data (times of recent maintenance, time and number of operations since last maintenance, etc.)
- Utilization levels
- Operator availability
- Inspection data (all measurements)
Yield data (scrap or rework)

Inventory levels (raw material, WIP, and finished goods)

Orders and due dates

Availability of tools and consumables

Some of this data \((suitably \ processed)\) can be used to determine parameters for future factory design.
Control actions (data to the factory):

- Part release
- Part dispatch (selection and routing)
- Part acceptance, rework, or scrap
- Process adjustment
- Maintenance initiation
Many factories are not instrumented.

Data is often collected erratically and inconsistently.

Many high tech factories (eg, semiconductor fabs) collect huge quantities of data but nobody looks at it.
If more or better data is made available, factories could be built and operated better:

- Less expensive
- Faster response times
- Improved quality
Manufacturing
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SBG demo of cell1
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DLB demo of cell1