

การสัมมนาหัวข้อ

การออกแบบทางกลในเครื่องจักรกลการเกษตร

Mechanical Design in Agricultural Machines



15 พฤษภาคม 2557

เวลา 09.00-12.15 น. ณ ห้องประชุม 212

ศูนย์นิทรรศการและการประชุมไบเทค บางนา กรุงเทพฯ

MTEC
a member of NSTDA

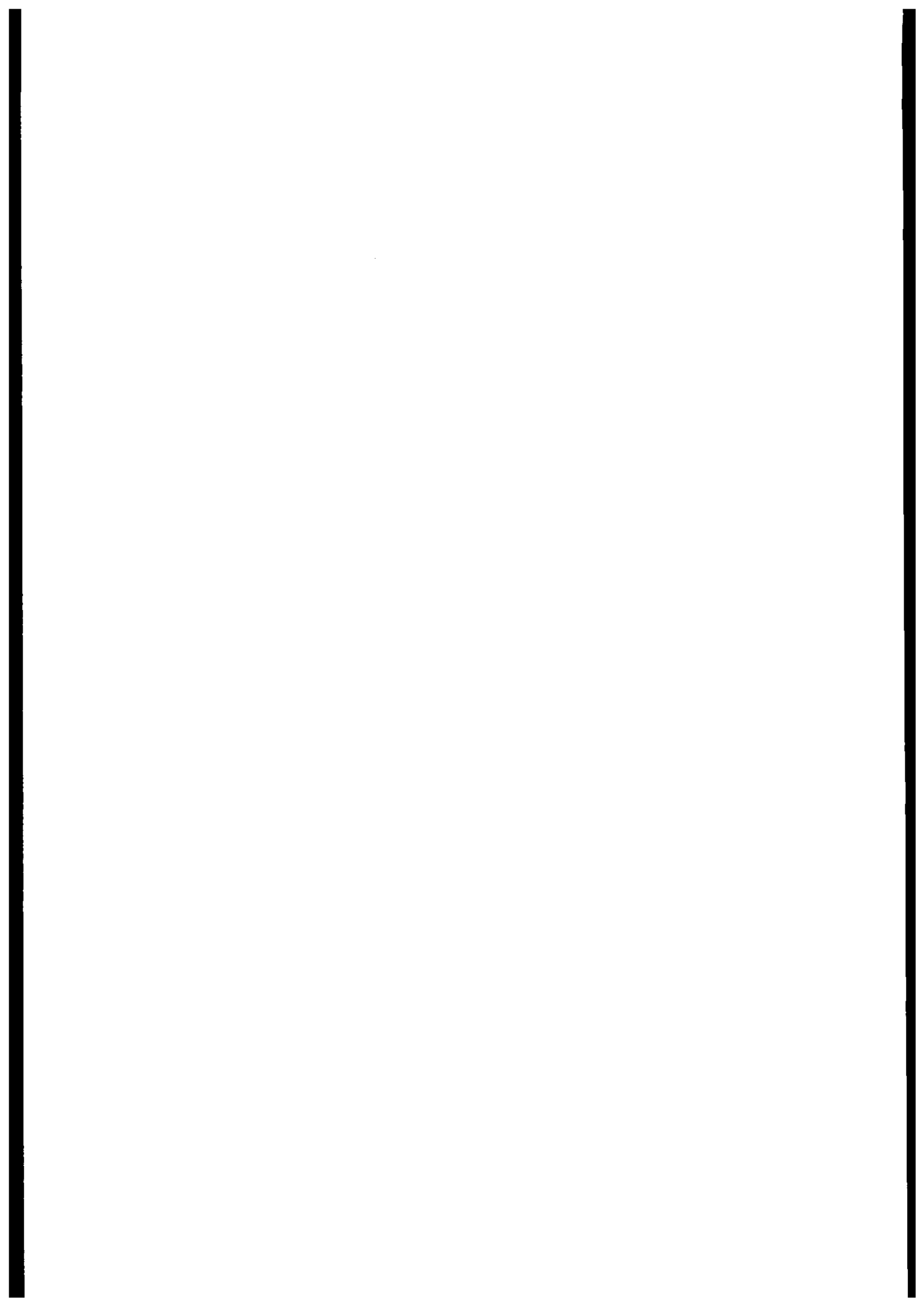


จัดโดย

ศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ (เอ็มเทค)
สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ
กระทรวงวิทยาศาสตร์และเทคโนโลยี

ร่วมกับ

สำนักงานปลัดกระทรวงวิทยาศาสตร์และเทคโนโลยี
กระทรวงวิทยาศาสตร์และเทคโนโลยี



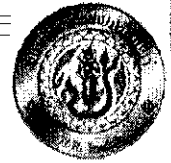
การออกแบบทางกลในเครื่องจักรกลการเกษตร (Mechanical Design in Agricultural Machines)

โดย

รศ. ดร. ชัชพล ชั่งชู

คณะวิศวกรรมศาสตร์ ม.เกษตรศาสตร์

SECTION 1: AGRICULTURAL MACHINE and FUTURE TREND



TYPES OF AGRICULTURE

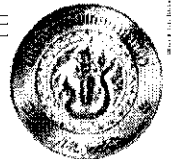
- According to its dependence of water:
- According to the scale of production and its relation to the market:

Dry land farming

Subsistence

Irrigation farming

Industrial agriculture



TYPES OF AGRICULTURE

- As seeking maximum performance or minimal use of other means of production, this will determine more or less ecological footprint:
- According to method and objectives:

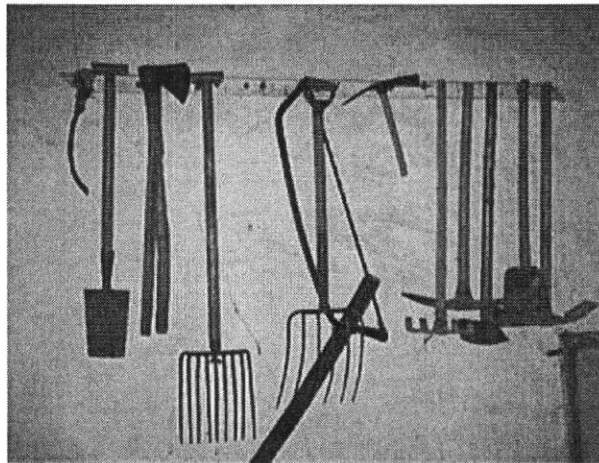
Intensive agriculture

Traditional agriculture

Extensive agriculture

Industrial agriculture

FARM HAND TOOLS



AGRICULTURAL MACHINERY, EQUIPMENT AND TOOL

- **Tractor:** is a very useful agricultural machine, with wheels or designed to move easily on the ground and pulling power enabling successful agricultural work, even in flooded fields.



AGRICULTURAL MACHINERY, EQUIPMENT AND TOOL

- **Walking Tractor:** agricultural machine is a single axle and is operated by handles, have median motor power and strength led to horticultural and ornamental work, can work in strong fields, but is preferably used in construction of gardens.



AGRICULTURAL MACHINERY, EQUIPMENT AND TOOL

- **Combine:** or mower is a powerful engine agricultural machine, comb cutter to cut the plants mature grain and a long rake that goes before the machine and rotates about a horizontal axis.



AGRICULTURAL EQUIPMENT

- Farm equipment is a group of devices designed to open furrows in the ground, shredding, spraying and fertilizing the soil.

AGRICULTURAL EQUIPMENT

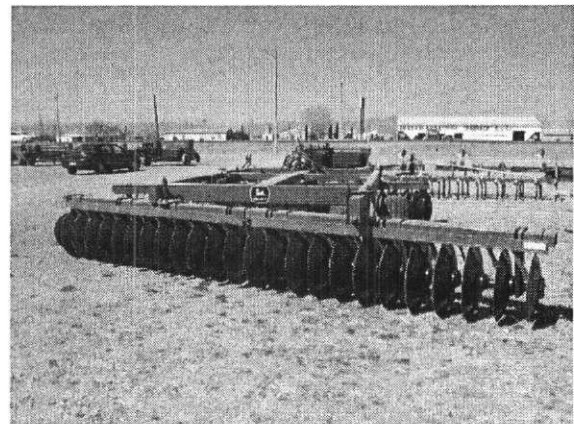
- **Plough:** agricultural equipment is designed to open furrows in the earth consists of a blade, fence, plough, bead, bed, wheel and handlebar, which serve to cut and level the land, hold parts of the plough, set shot and to serve as handle. There are various types of ploughs but the best known are:
 - Mouldboard plough, formed by the grating blade and mouldboard
 - Disc plough, disc concave formed by deep grooves to open
 - Shallow ploughing to remove the topsoil
 - Subsoil plough to remove the soil depth

AGRICULTURAL EQUIPMENT



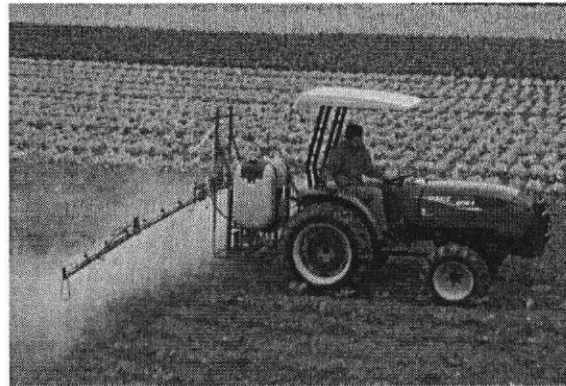
AGRICULTURAL EQUIPMENT

- **Drag:** agricultural equipment is designed to break up the parts and parcels of land that have been removed by the plough, are composed of a frame, which can be made of wood and metal teeth and the latch that attaches to tractor.



AGRICULTURAL EQUIPMENT

- **Sprayer:** it is a farm equipment designed to spray, is composed of a liquid tank, pressure pump, cap, mouth, tank and pressure valve, belts, hose, faucet and nozzle where the liquid to spray out, is insecticide, fungicide or herbicide. The hand sprayer is placed in the back of the sprayer and this has placed in the mouth and nose a special mask to prevent strong odours dismissed by the substance that expels the sprayer will harm.



AGRICULTURAL EQUIPMENT

- **Tillage planter:** is a machine to place the seeds on the seedbed without prior tillage.



AGRICULTURAL EQUIPMENT

- **Fertilizer:** agricultural equipment is designed to distribute fertilizer is composed of three main parts: the hopper or storage of fertilizer, the drop tube of fertilizer and fertilizer distributor.



AGRICULTURAL EQUIPMENT

- **Packing:** agricultural equipment is designed for packaging or packing cereal straw or other baled forage grasses (also called bales or alpacas).



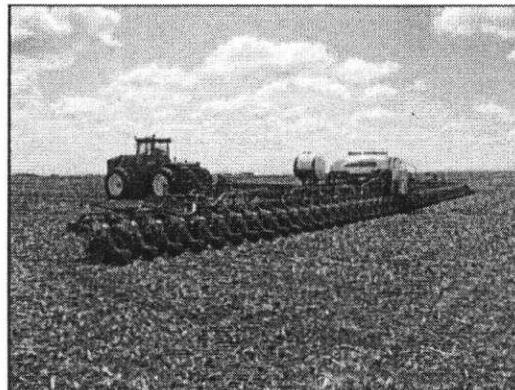
FUTURE TRENDS in AGRICULTURE ENG.

- Automation
- Robotics
- Data Management
- Electrification

FUTURE TRENDS in AGRICULTURE ENG.

Automation:

- GPS control for wide planters, sprayers
- Headland management
- Selective weed control
- Autonomous tractors and machines



FUTURE TRENDS in AGRICULTURE ENG.

Robotics:

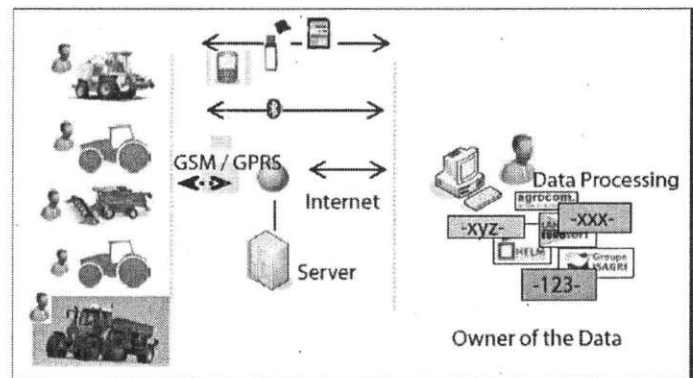
- Autonomous vehicles for seeding, weeding, fertilizing and spraying



FUTURE TRENDS in AGRICULTURE ENG.

Data Management:

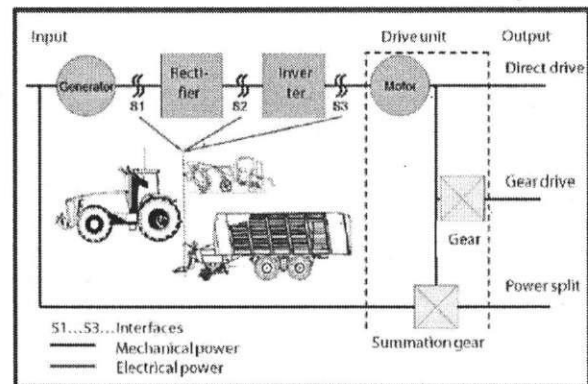
- Yield mapping
- Variable application rates
- Documentation
- Traceability
- Etc.



FUTURE TRENDS in AGRICULTURE ENG.

Electrification:

- Fuel saving
- Higher efficiency
- Drive controls
- Automatization



EU – STRATEGIC RESEARCH for 2020

- **Farming:** The future farming in European is precision farming. There are two types, which are
 - Precision livestock farming
 - Precision crop farming

EU – STRATEGIC RESEARCH for 2020

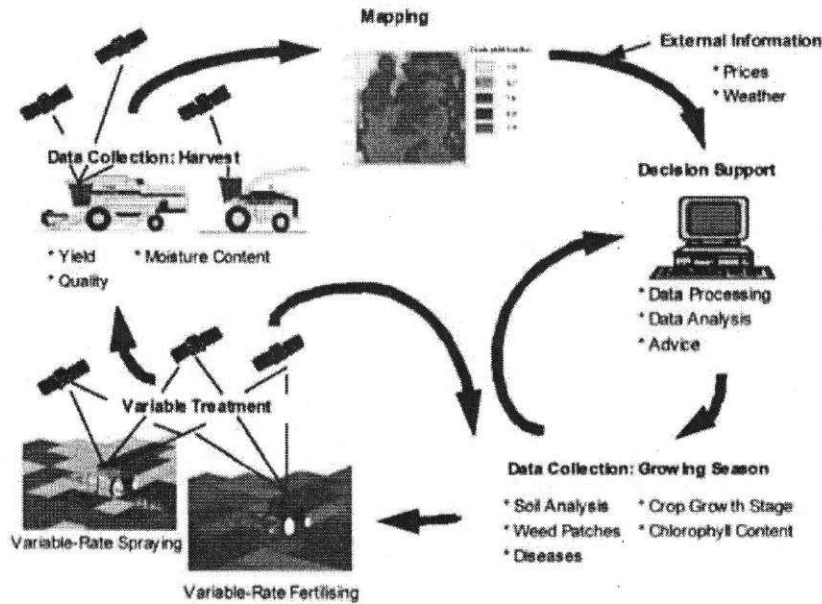
- **Technology:** Electronics, automation and robotics have been widely used. Farm power and machinery have changed to use renewable energy sources like bio-based synthetic fuel, hydrogen and fuel cell. Farm equipment will be more specialized and more optimized with high efficiency.

Note: Many EU agriculture equipment manufacturers are still SME but they are technology-driven enterprises.

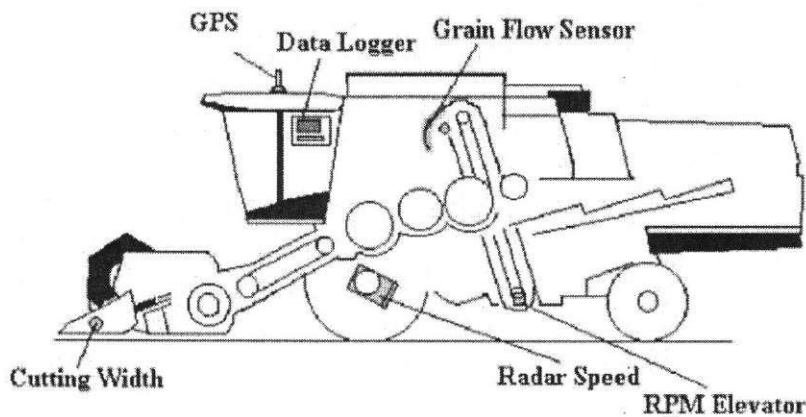
ADVANCED TECHNOLOGIES and AUTOMATION in AGRI. MACHINE

- Examples of advanced precision agriculture components: combine harvester, sprayer, and fertilizer spreader.
- In order to control performance of these machines/equipments/components, several information need to be captured by sensors.

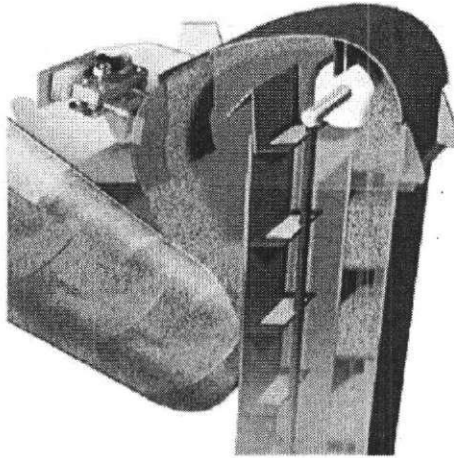
ADVANCED TECHNOLOGIES and AUTOMATION in AGRI. MACHINE



ADVANCED TECHNOLOGIES and AUTOMATION in AGRI. MACHINE

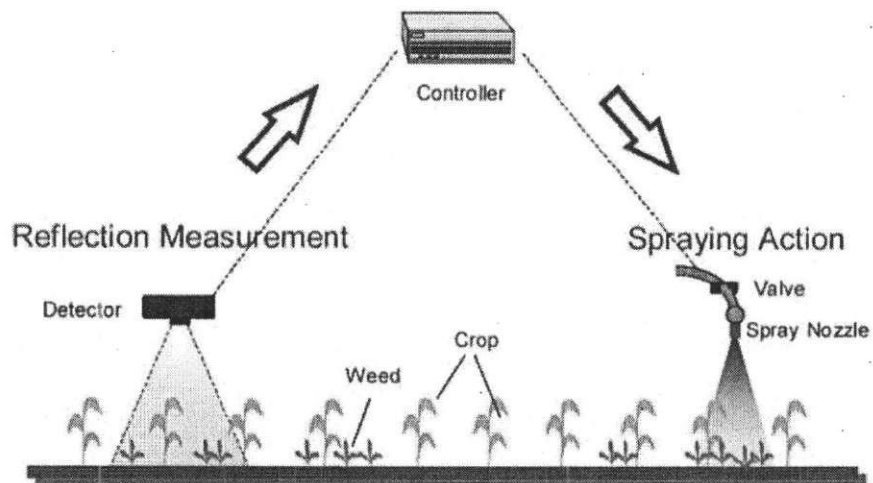


ADVANCED TECHNOLOGIES and AUTOMATION in AGRI. MACHINE



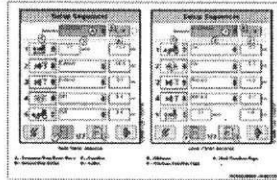
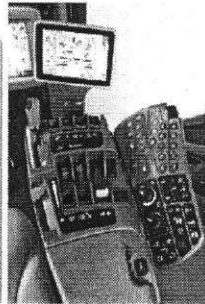
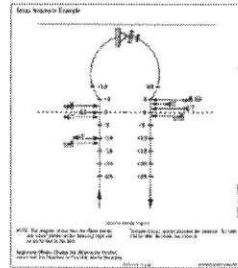
ADVANCED TECHNOLOGIES and AUTOMATION in AGRI. MACHINE

Processing of Reflection Measurements
Setting Appropriate Spraying Action



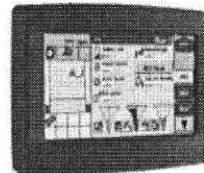
EXAMPLES of COMMERCIAL ADVANCED AGRI. MACHINE

intelligent Total Equipment Control
(John Deere iTEC Pro™ Guidance Systems)

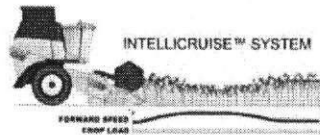


EXAMPLES of COMMERCIAL ADVANCED AGRI. MACHINE

Harvest Sensing and Control
(New Holland CR 9000)

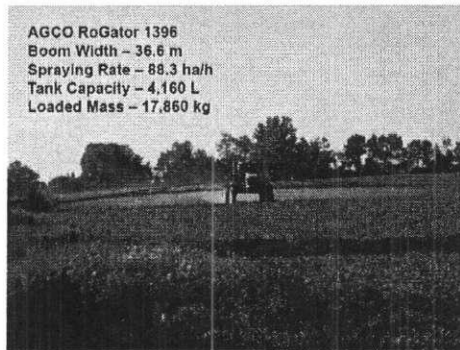


GRAIN CAM™ PURITY

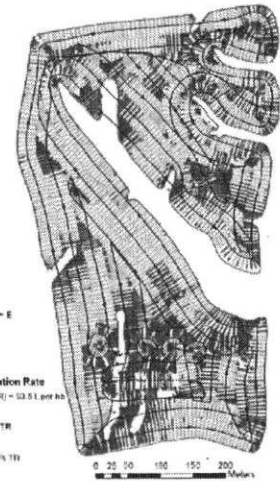


INTELLICRUISE™

EXAMPLES of COMMERCIAL ADVANCED AGRI. MACHINE



Spray
Application
Total
Variation

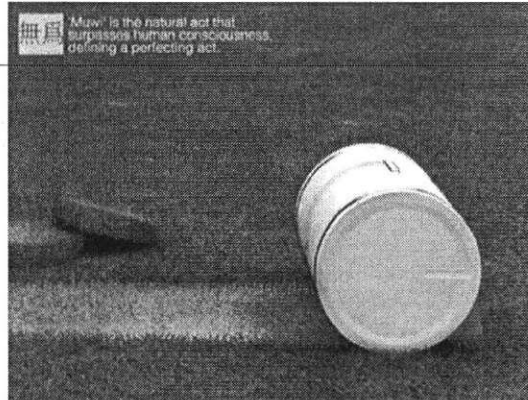


Current Trend Summary

- Machines are ~~controlled~~ operated by humans

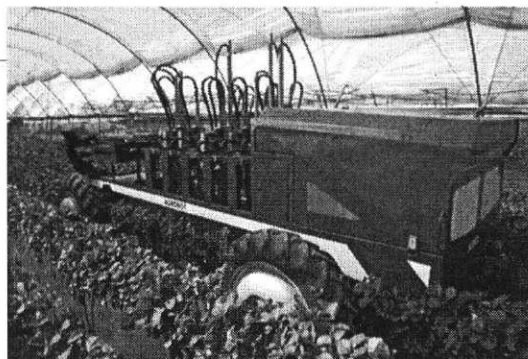
EXAMPLES of NEXT GENERATION MACHINE

- Roboticization
- Automaticization



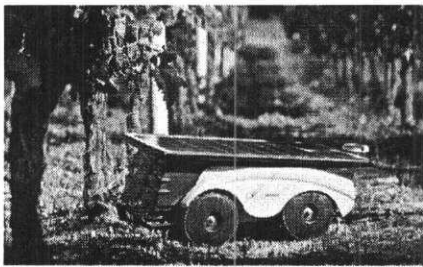
EXAMPLES of NEXT GENERATION MACHINE

- Roboticization
- Automaticization



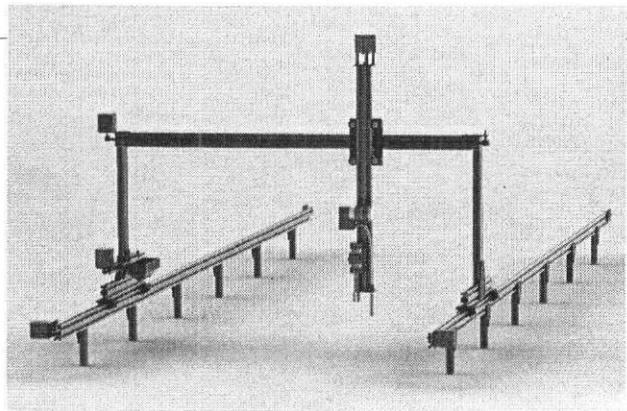
EXAMPLES of NEXT GENERATION MACHINE

- Robotization
- Automaticization



EXAMPLES of NEXT GENERATION MACHINE

- Robotization
- Automaticization



EXAMPLES of NEXT GENERATION MACHINE

- Robotization
- Automaticization



SECTION 2: AGRICULTURAL MACHINES for THAILAND

AGRICULTURE in THAILAND

Sustainable Agriculture (เกษตรยั่งยืน):

- Agroforestry (วนเกษตร)
- Integrated Farming (เกษตรผสมผสาน)
- The New Theory (เกษตรทฤษฎีใหม่)
- Organic Agriculture (เกษตรอินทรีย์)
- Natural Agriculture (เกษตรธรรมชาติผสมผสาน)

AGRICULTURE in THAILAND

Thai's Agriculture:

- Both dry and irrigation farming
- Small industrial agriculture

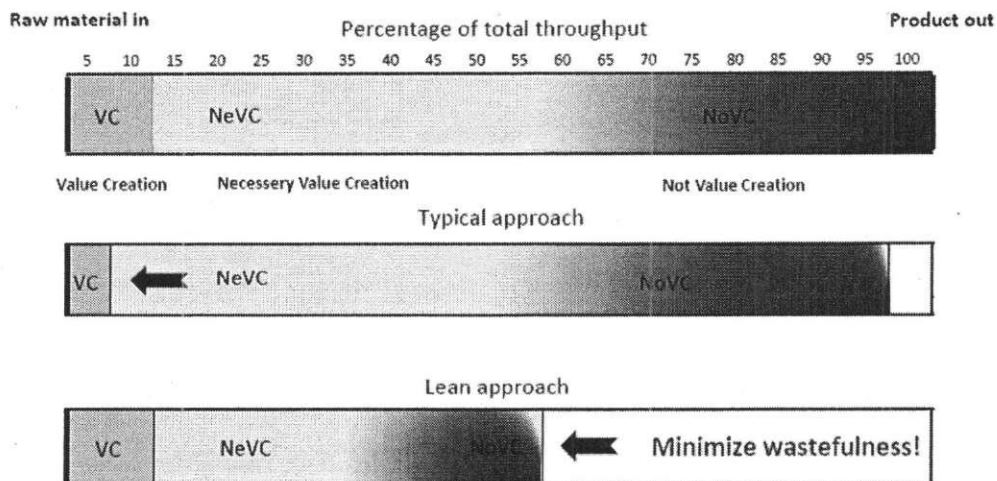
- Change from “ทำกิน” to “ทำมาหากิน”
- Should be “ทำกิน” plus “ทำมาหากิน”

LEAN PRINCIPLES in THAI'S AGRICULTURE

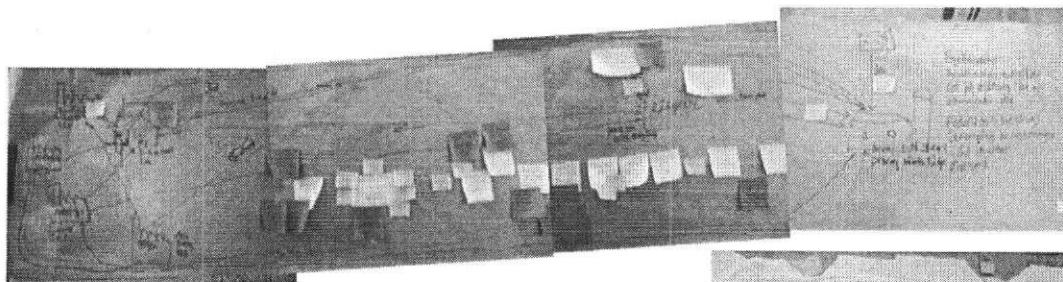
Womack and Jones (1996) identify the following 5 components of Lean:

1. Specify Value
2. Identify the Value Stream
3. Make Value flow without interruptions
4. Let the customer Pull Value
5. Pursue Perfection
 - Perfection is sought through the use of standards, kaizen/kaikaku, 5 Why's, 5S's, 5M's, and other methods of continuous improvement

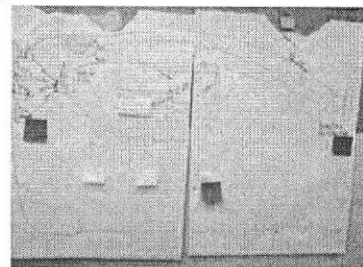
Creation of value



Valuestream mapping - present

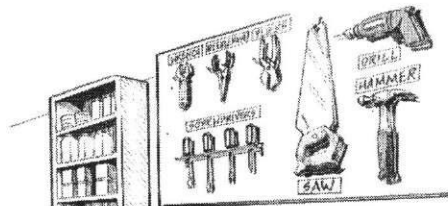


Desired position?





1. Sort



2. Stabilize

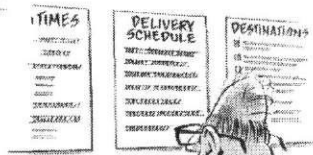


5. Sustain

5 S's



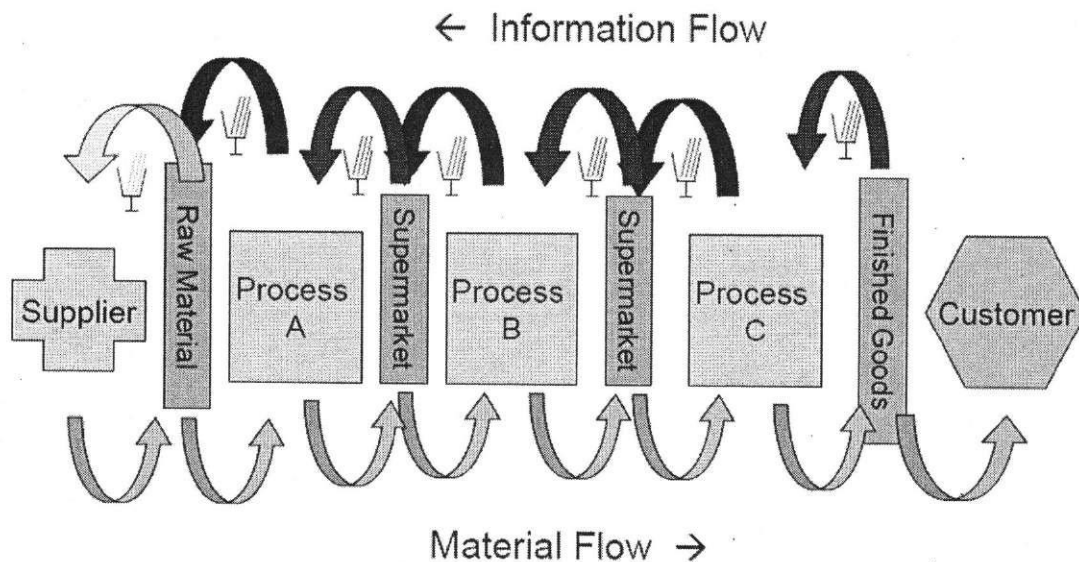
3. Shine

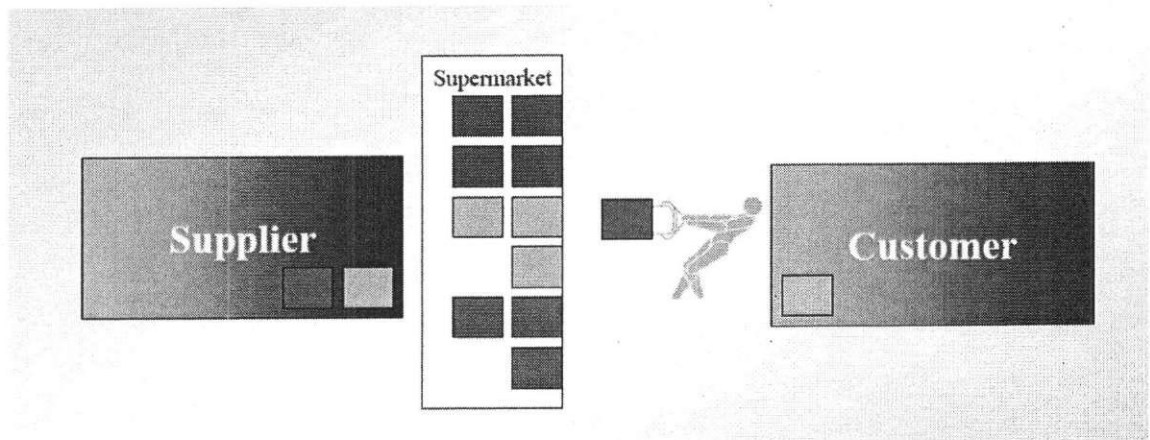


4. Standardize

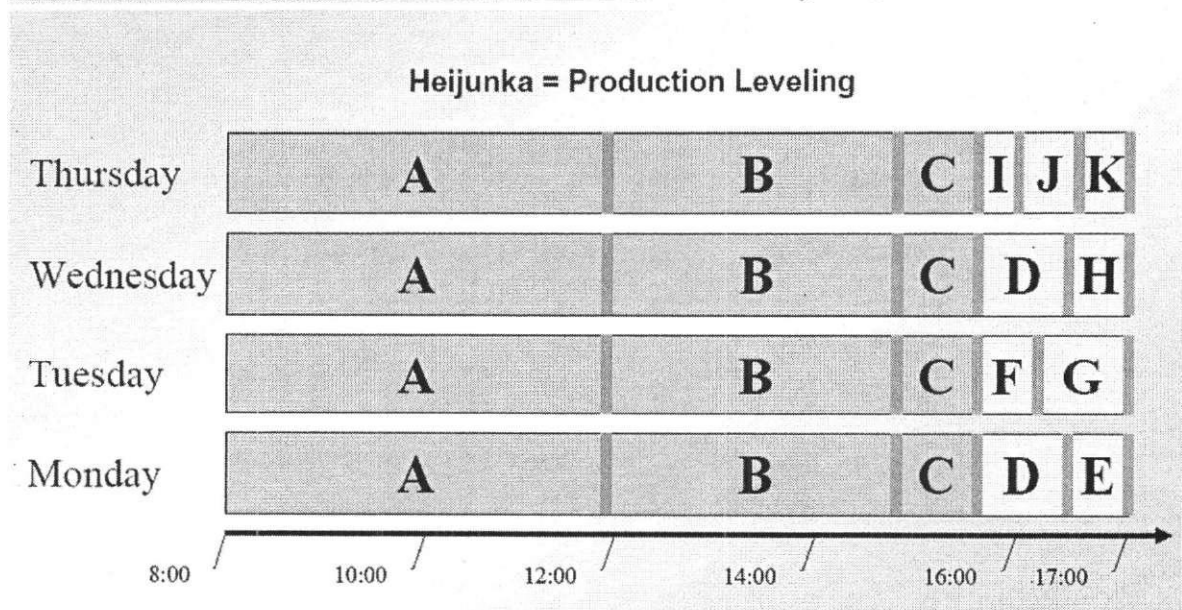


Kanban - Pull

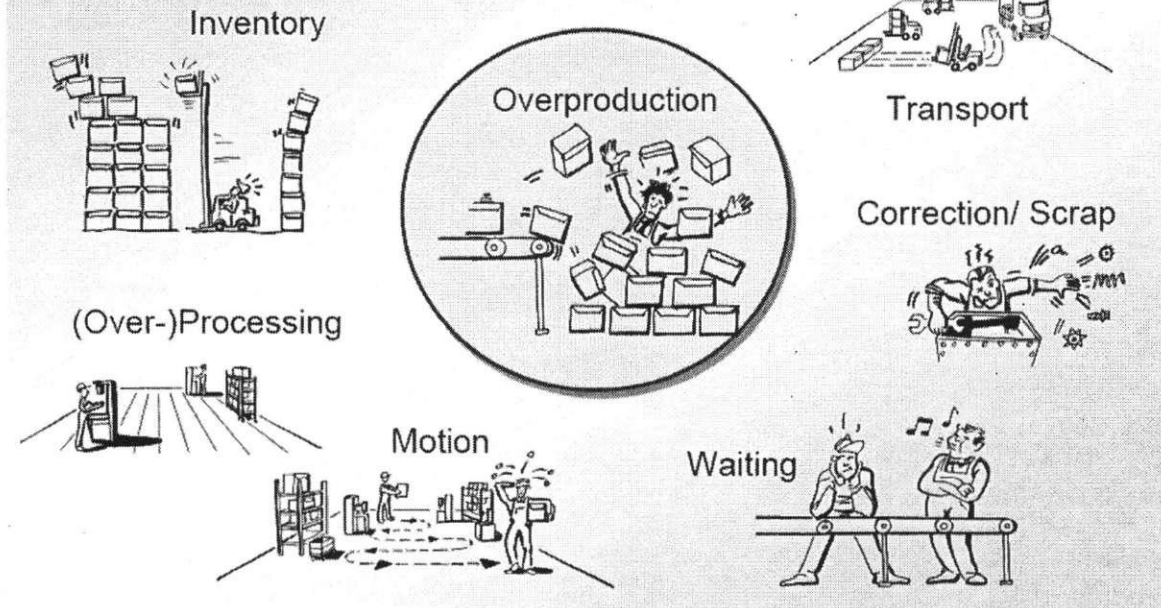




The target of production leveling: Every Part every Day!

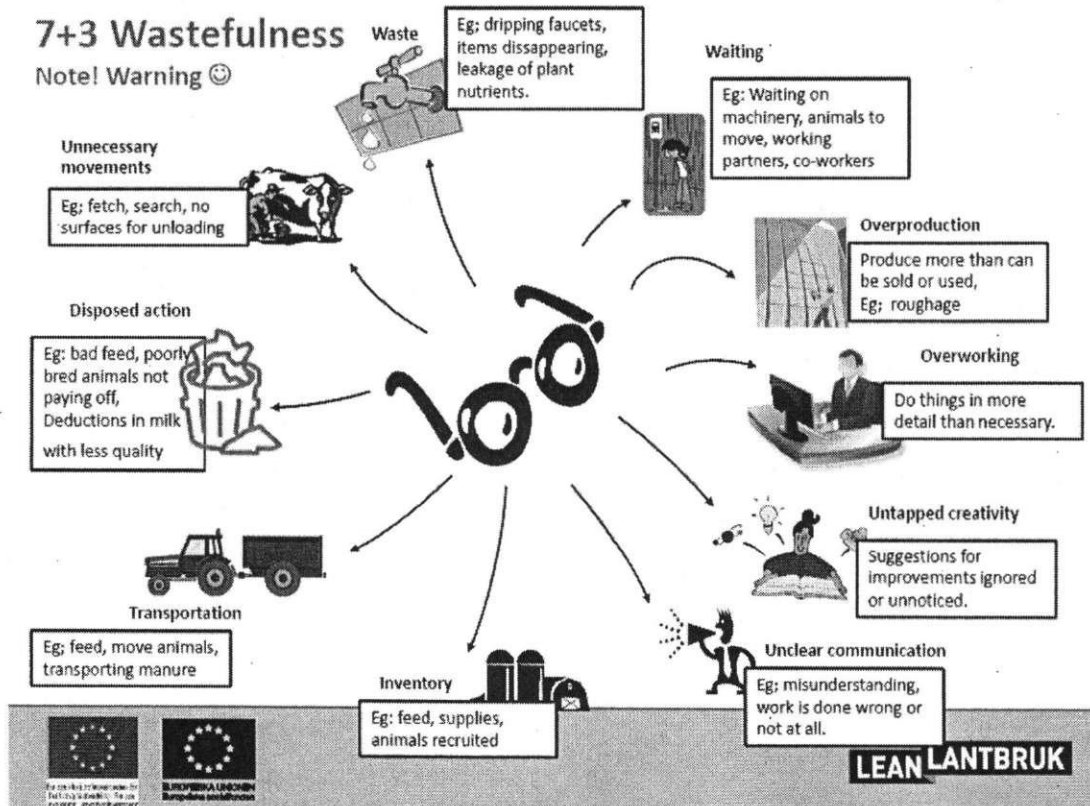


Muda – the 7 types of waste

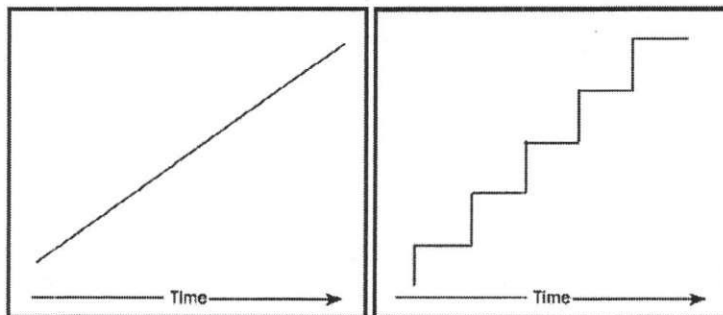
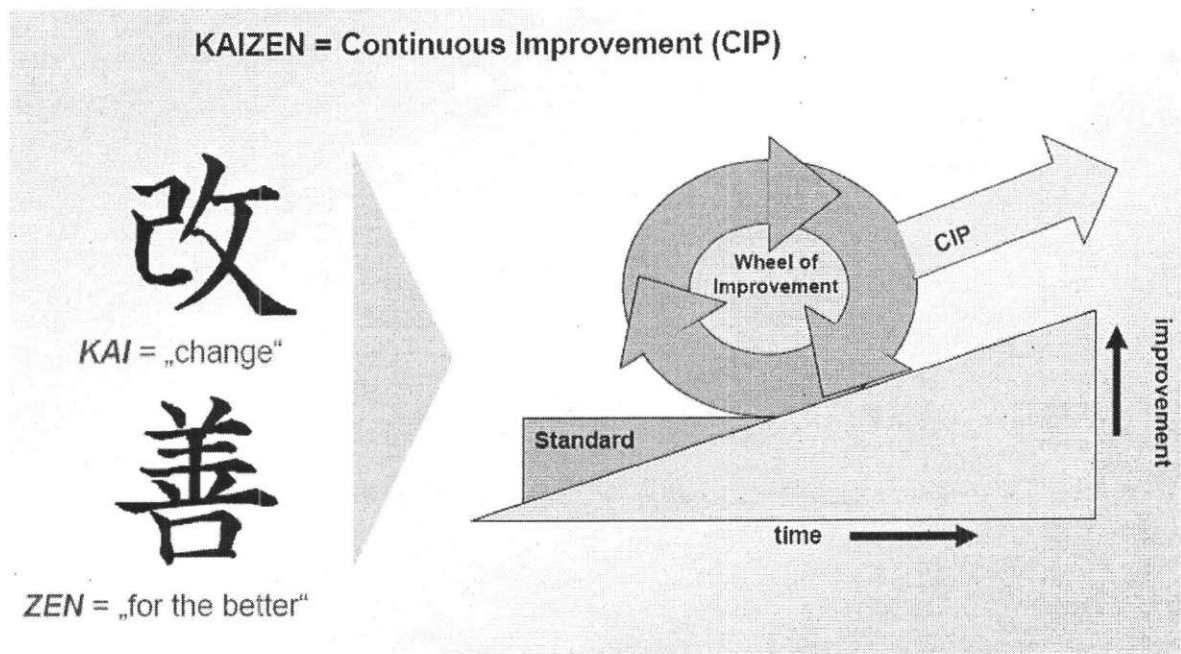


7+3 Wastefulness

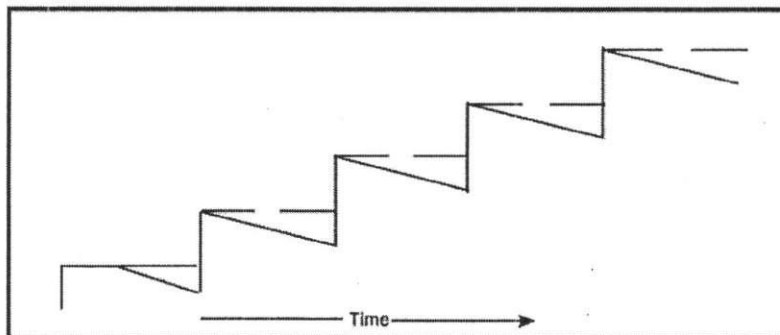
Note! Warning ☹️



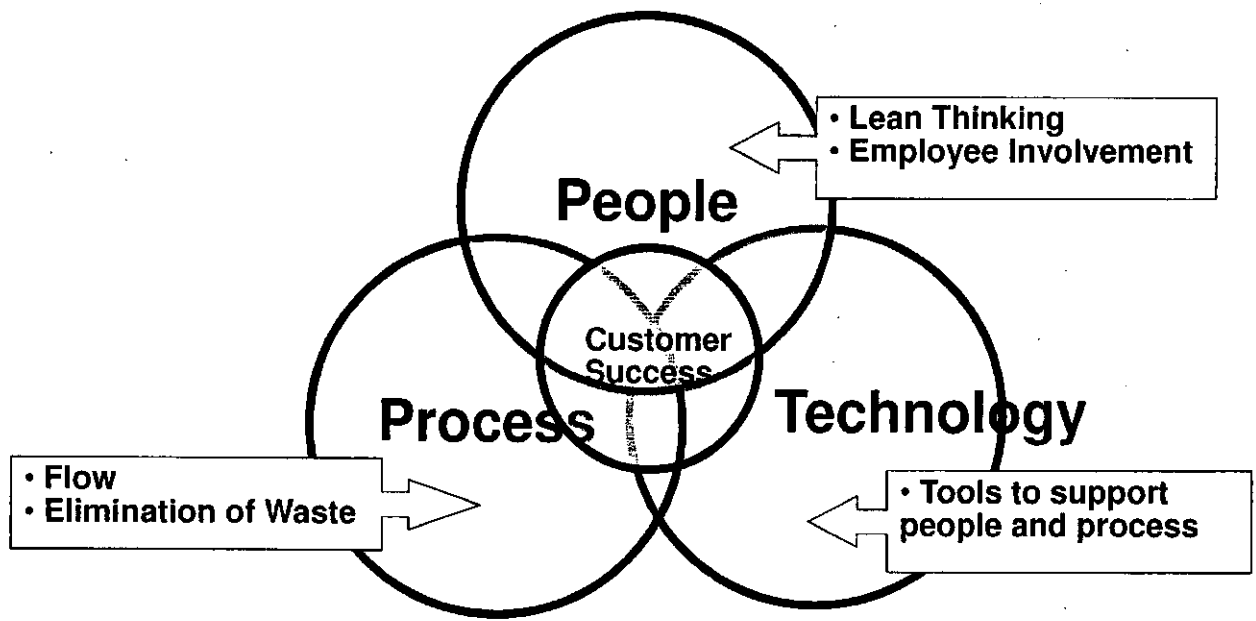
KAIZEN = Continuous Improvement (CIP)

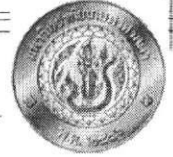


Ideal Pattern for Kaizen Ideal Pattern for Innovation



Actual Pattern for Innovation without maintenance





SECTION 3:
AGRICULTURAL MACHINE DESIGN



NEW CONCEPT for AGRI. MACHINE INDUSTRY

**Sell Solution
not Machine**



NEW CONCEPT for AGRI. MACHINE INDUSTRY

Objective:

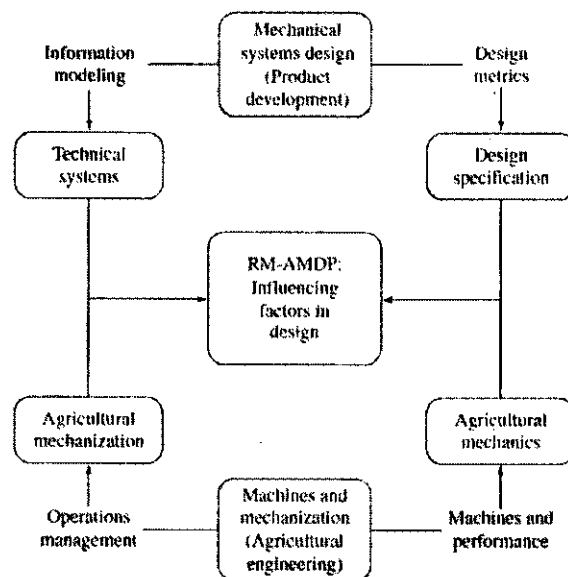
- To develop solution for customer's need

Constraints:

- Performance / Machine capability
- Weight / Size
- Price / Cost
- Operating cost
- HMI
- Maintainability
- Agriculture type
- Size of farm
- Etc.

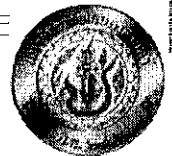
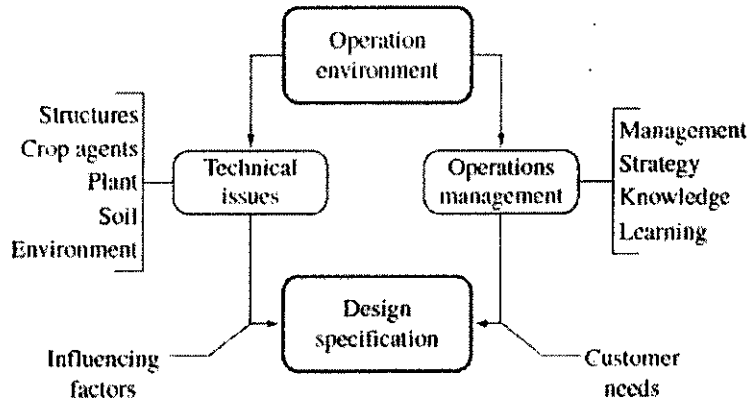


INFLUENCE FACTORS in AGRI. MACHINERY DSG.

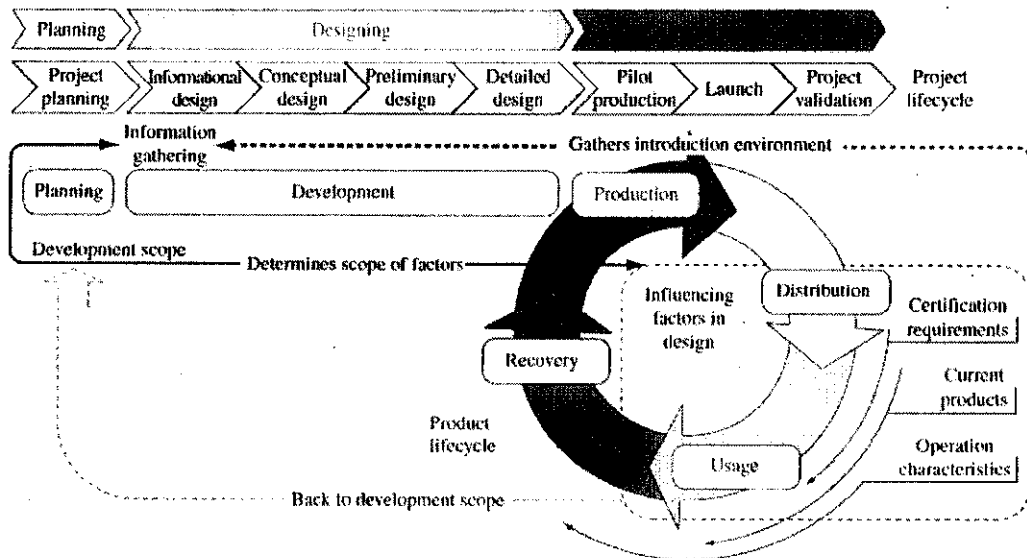


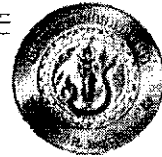


INFLUENCE FACTORS in AGRI. MACHINERY DSG.

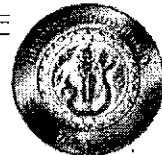
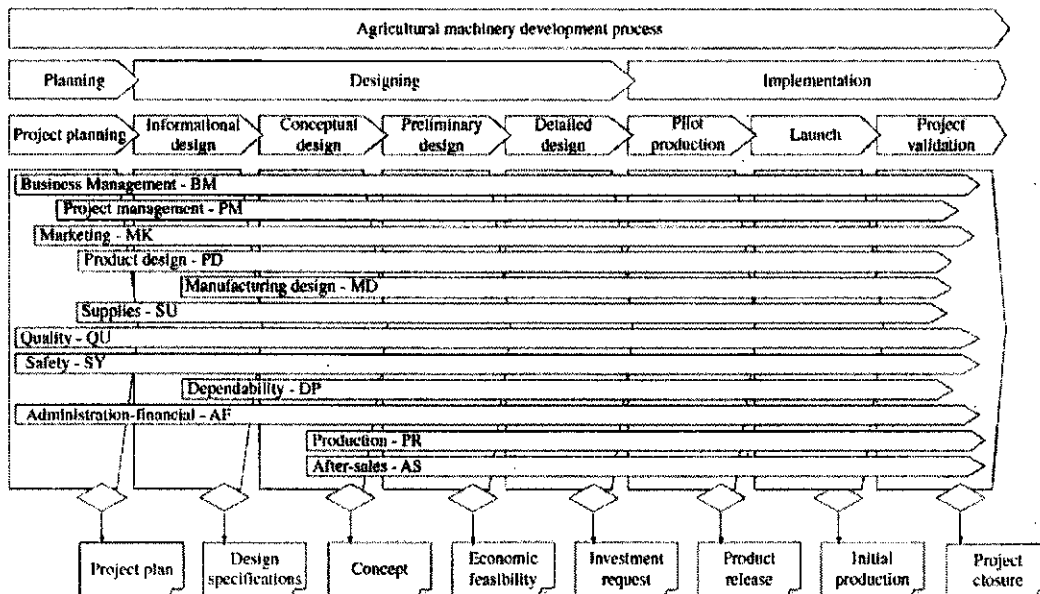


INFLUENCE FACTORS in AGRI. MACHINERY DSG.

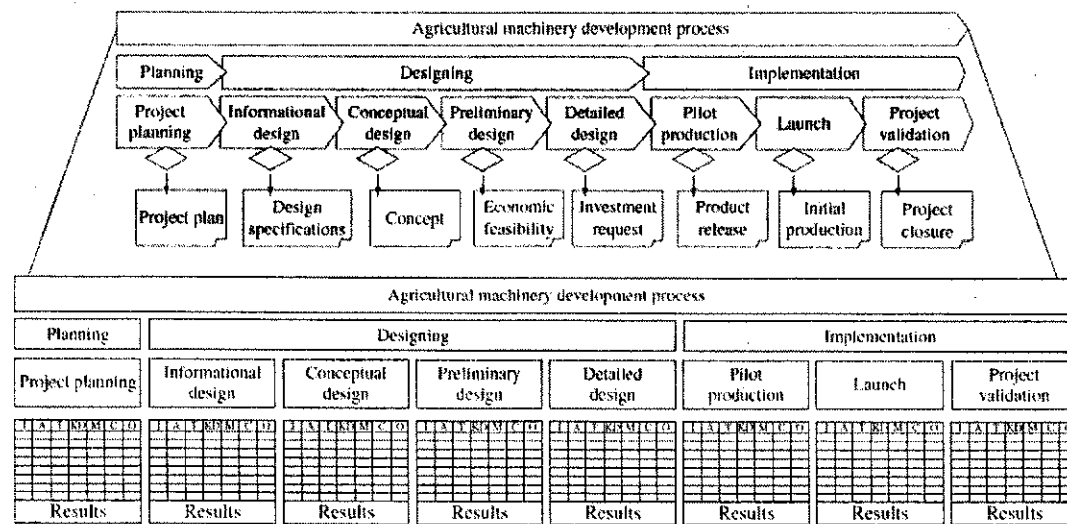


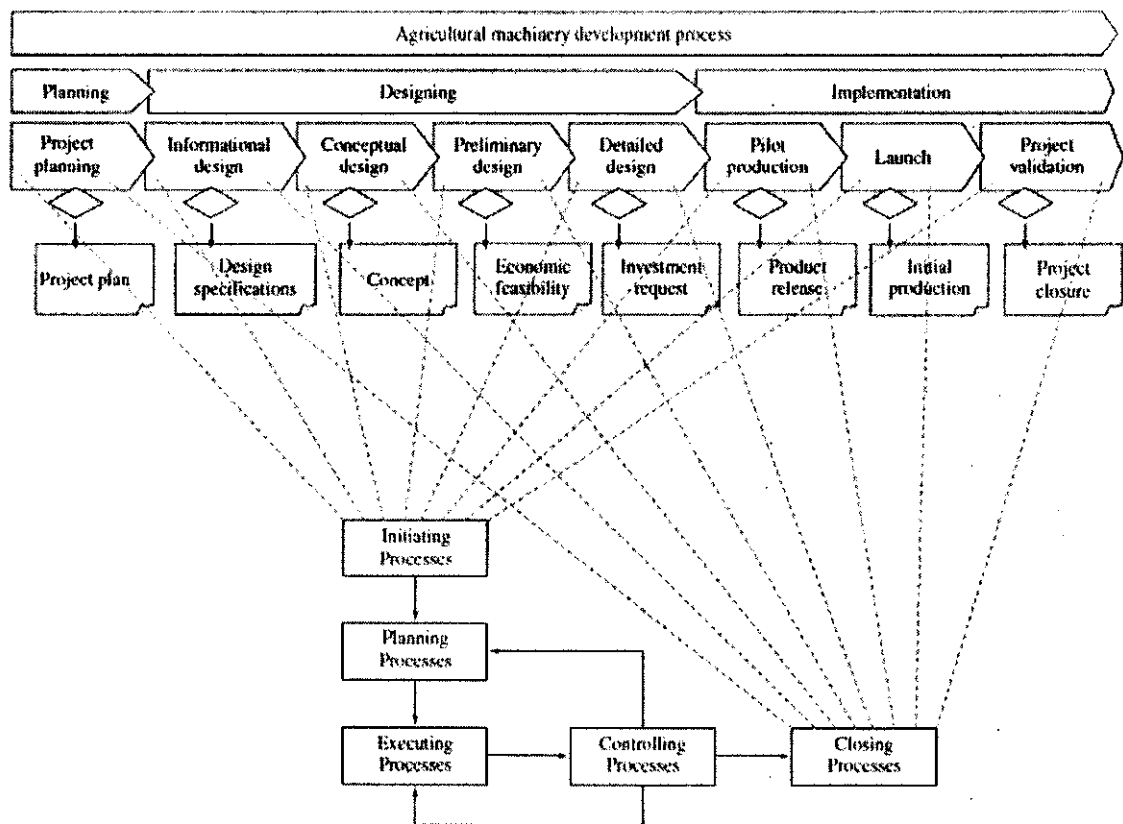
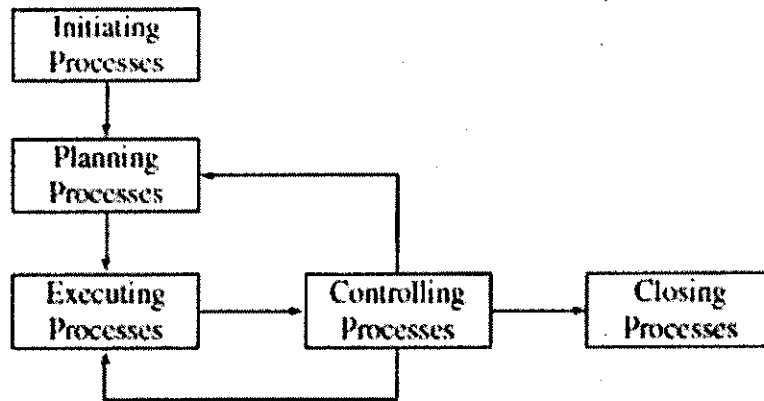


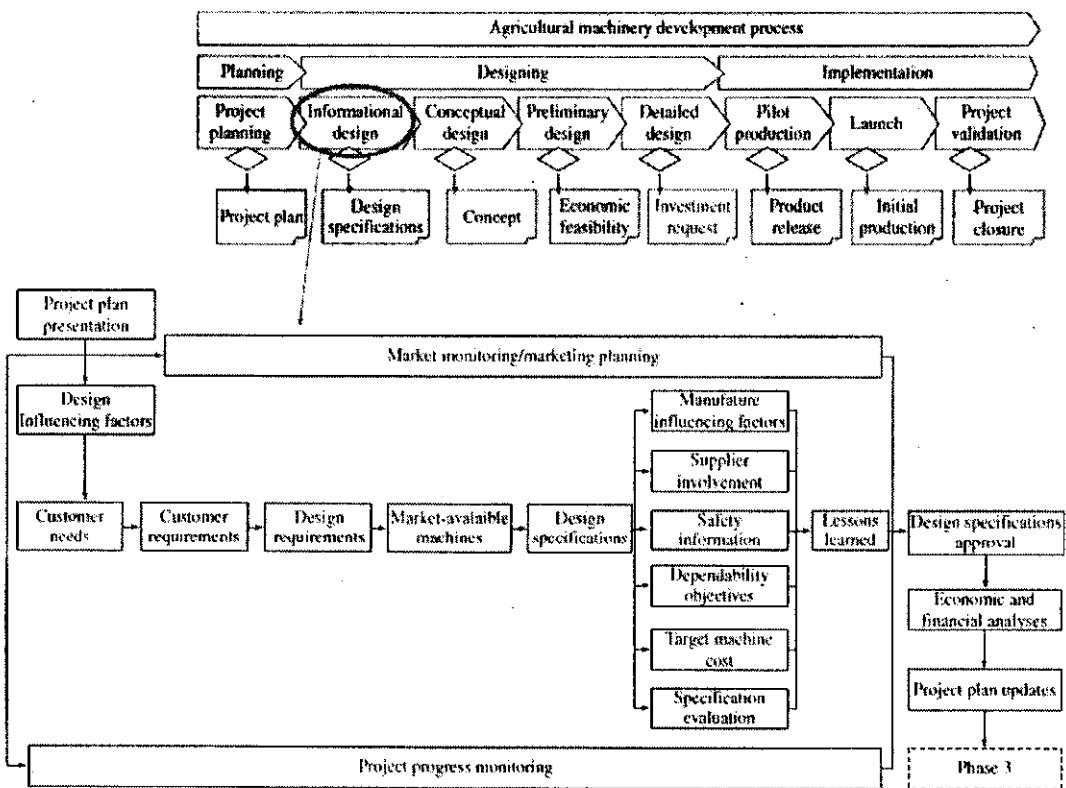
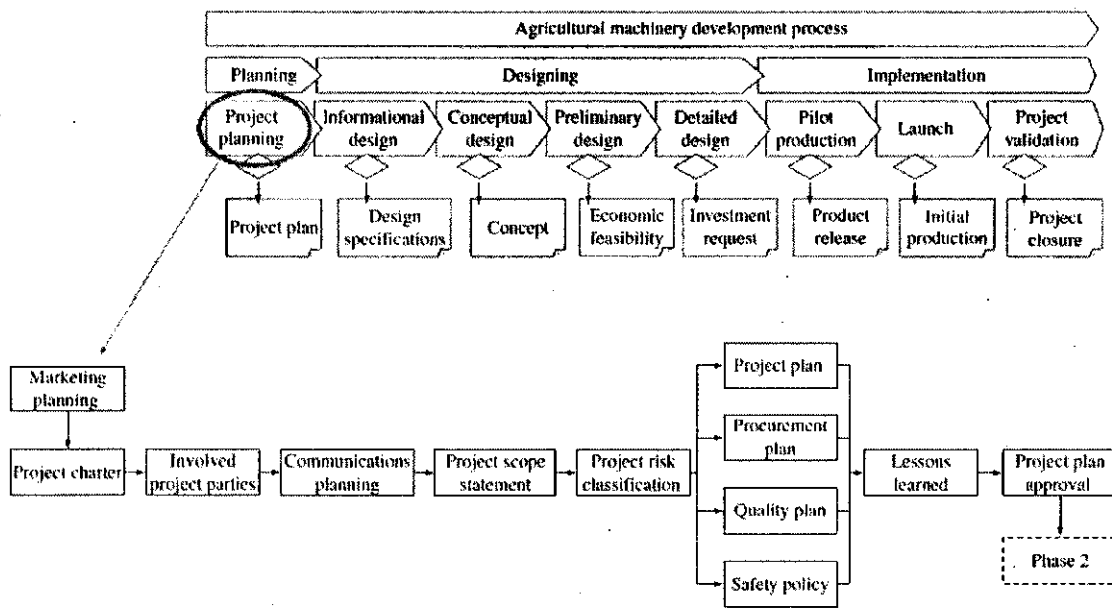
REFERENCE MODEL FOR AGRI. MACHINE DEV.

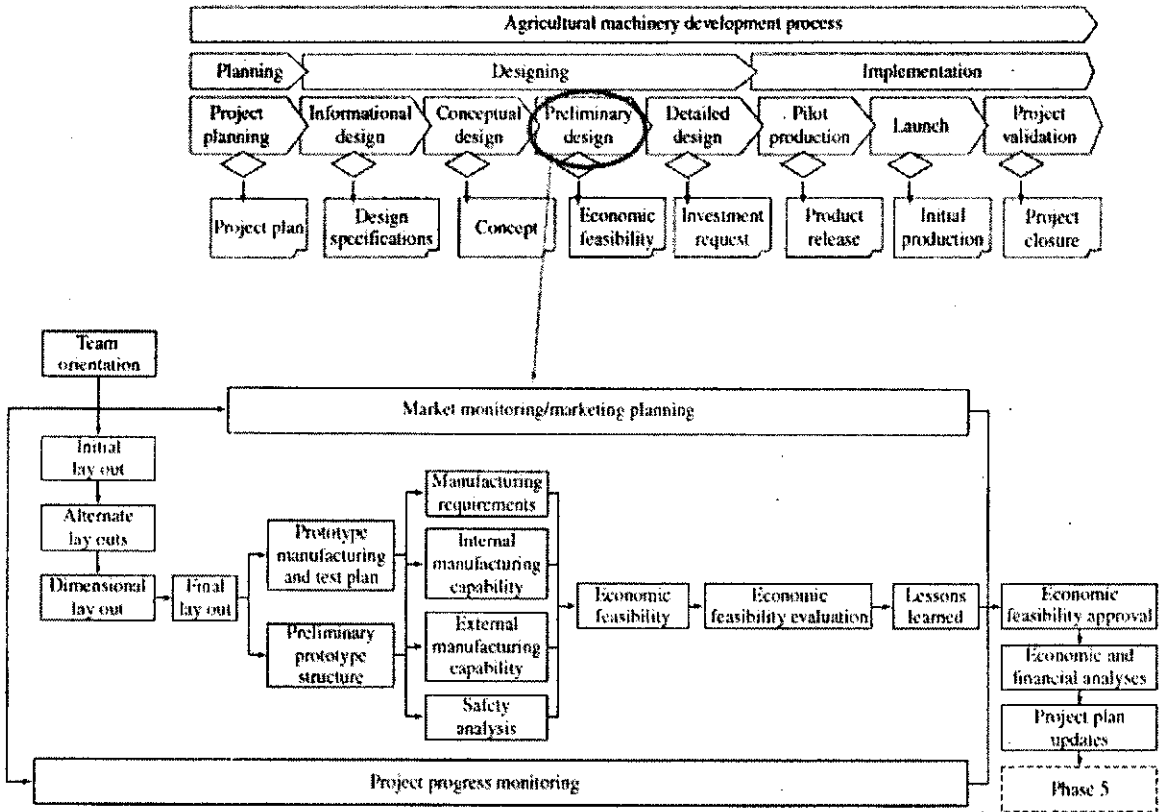
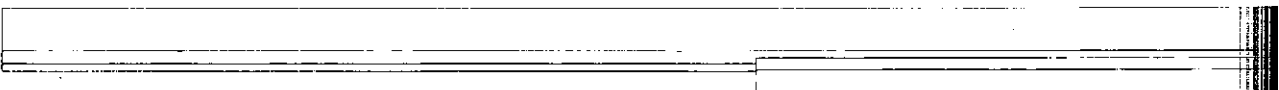
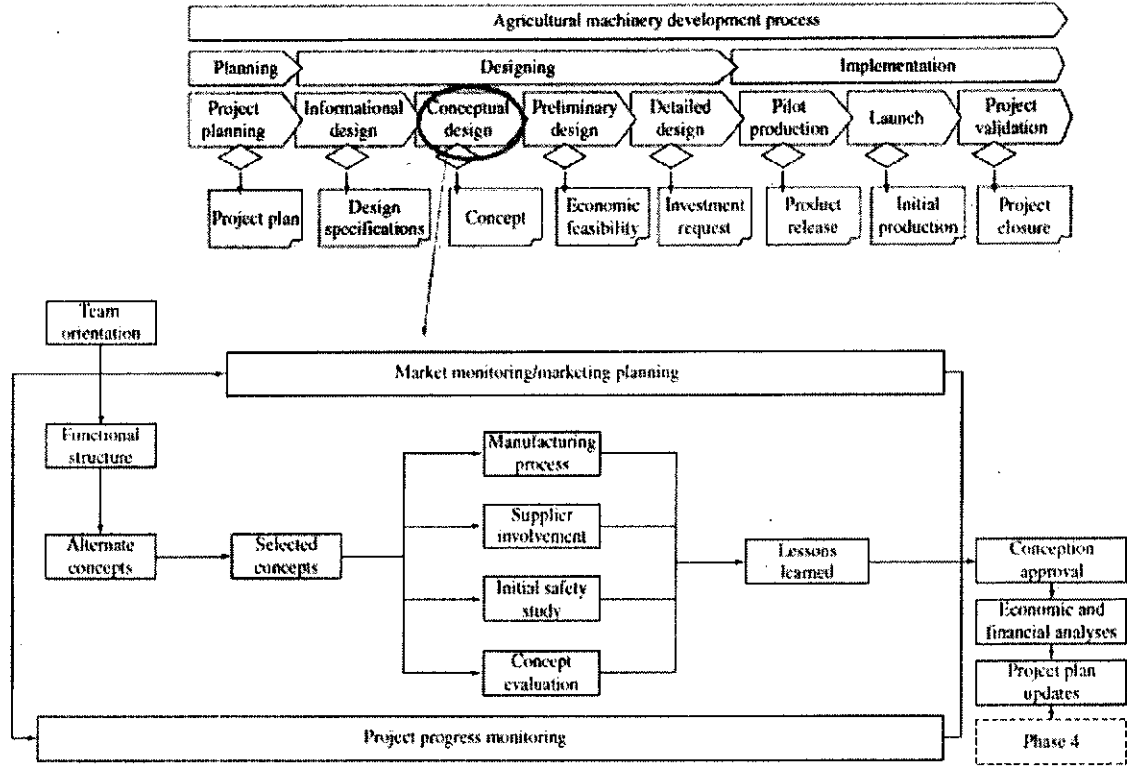
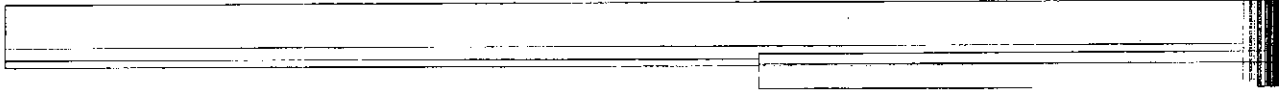


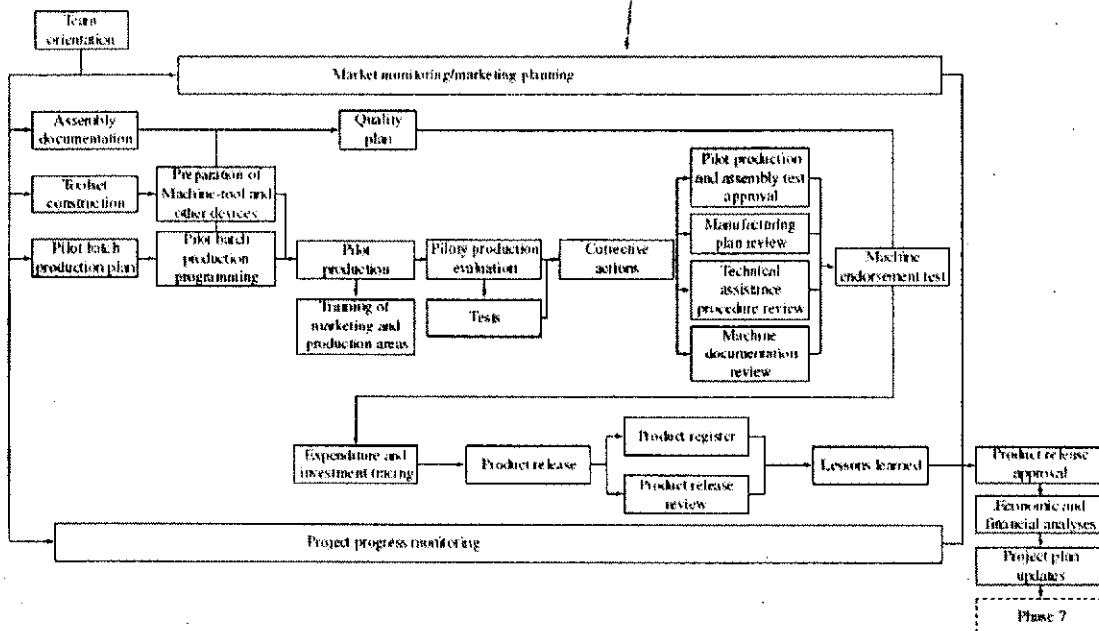
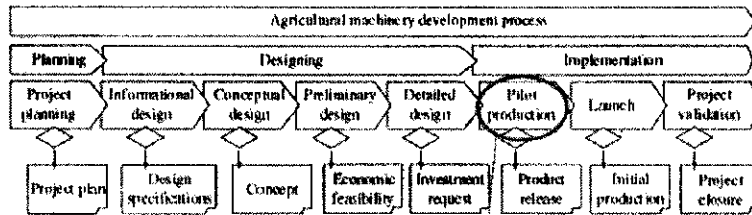
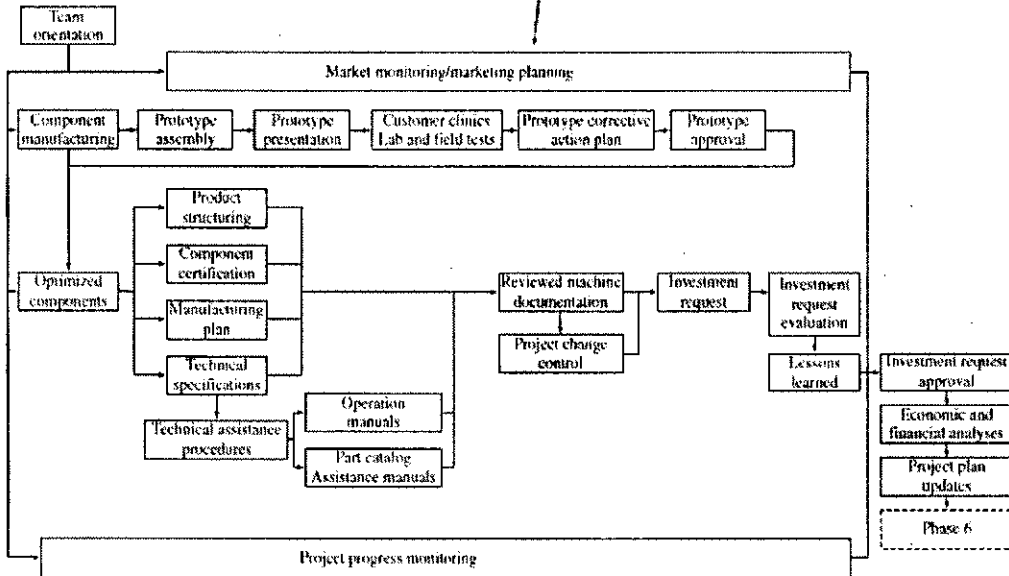
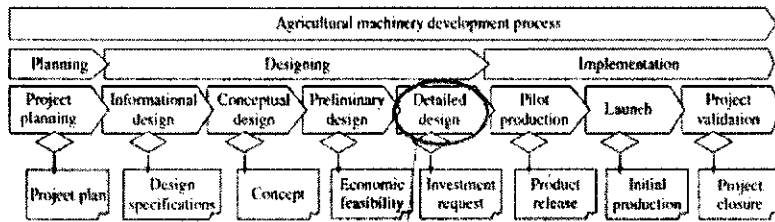
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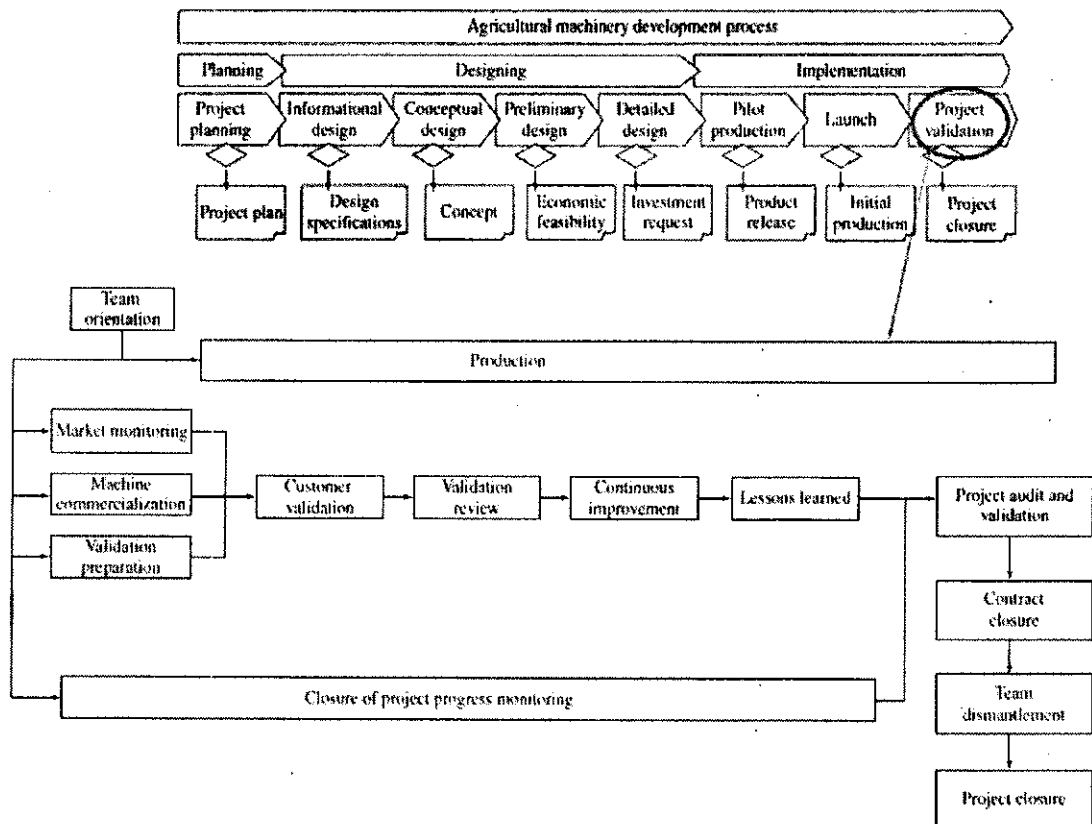
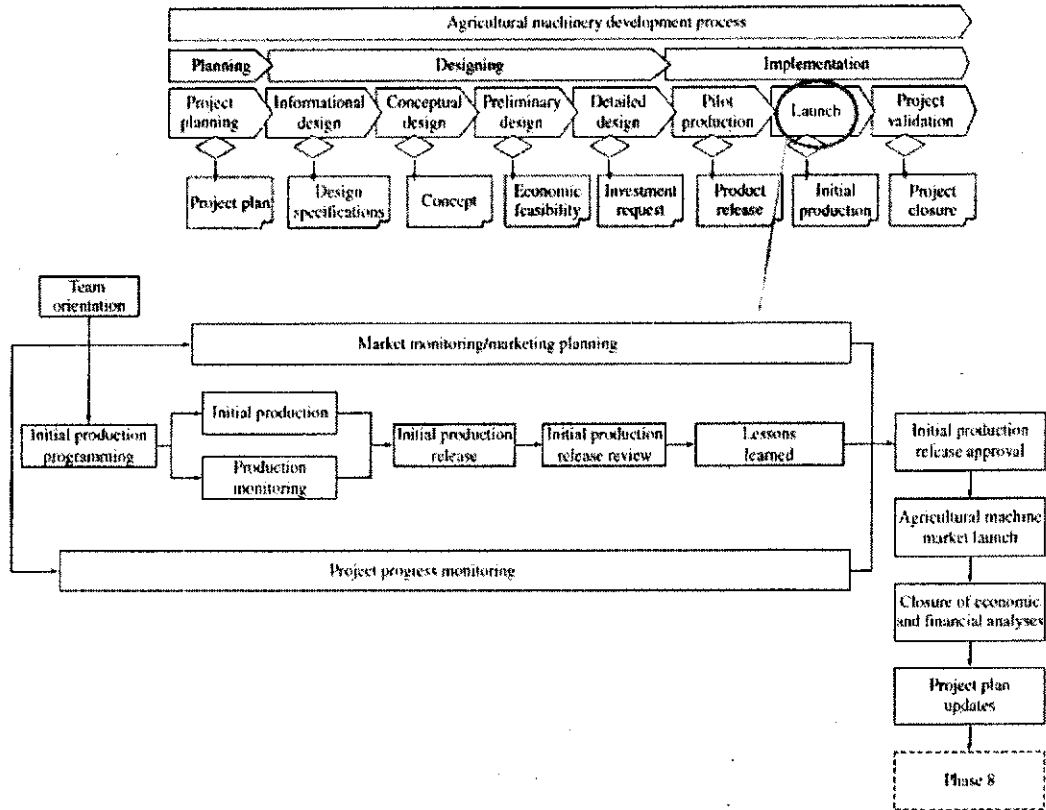








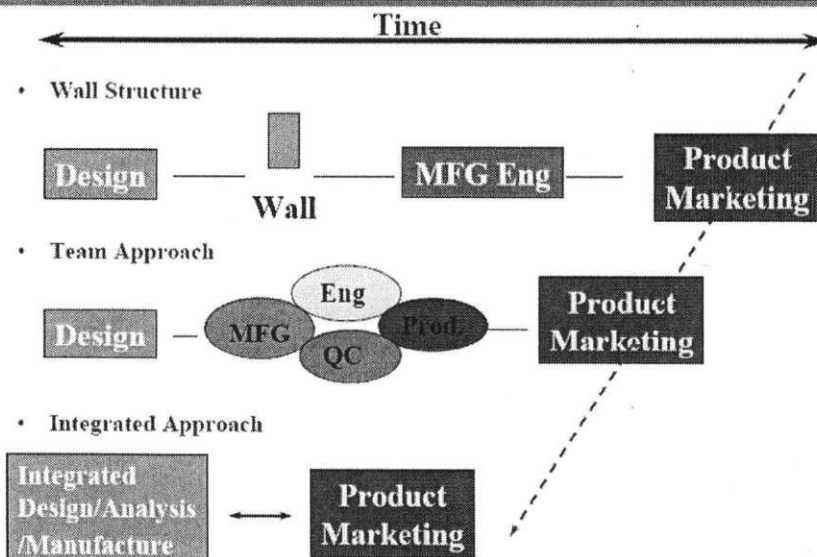




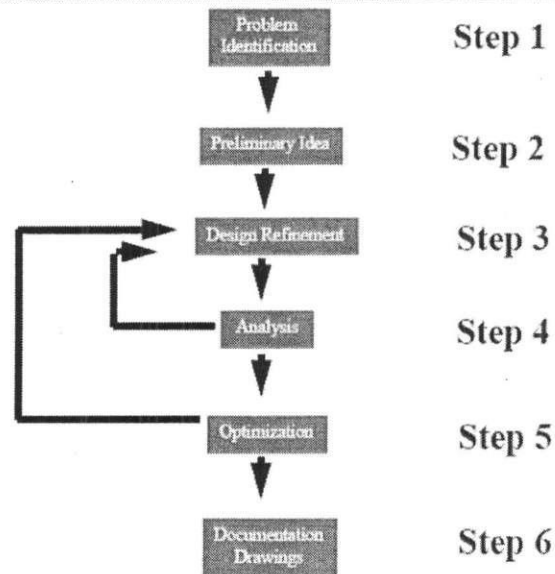
CAD / CAM / CAE

- CAD – Computer Aided Design
- CAM – Computer Aided Manufacturing
- CAE – Computer Aided Engineering

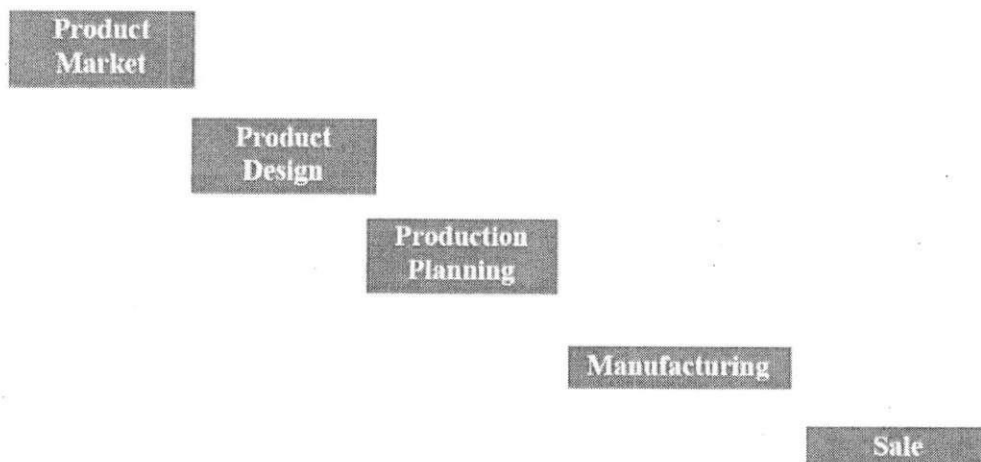
Evolution from Traditional to Concurrent Engineering

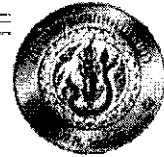


Conventional Product Design Process



Classical Manufacturing Model





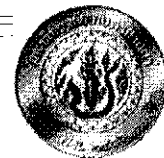
Product Development in:

- Sequential Step
- Design/Manufacturing/Market Separation
- Communication by 2D Drawing

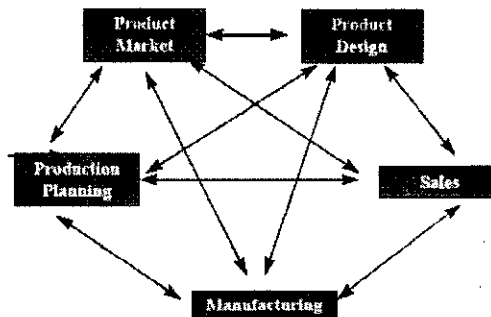
Result in:

- Slow Product Development Cycle
- High Cost
- Poor Quality

No Competitiveness !

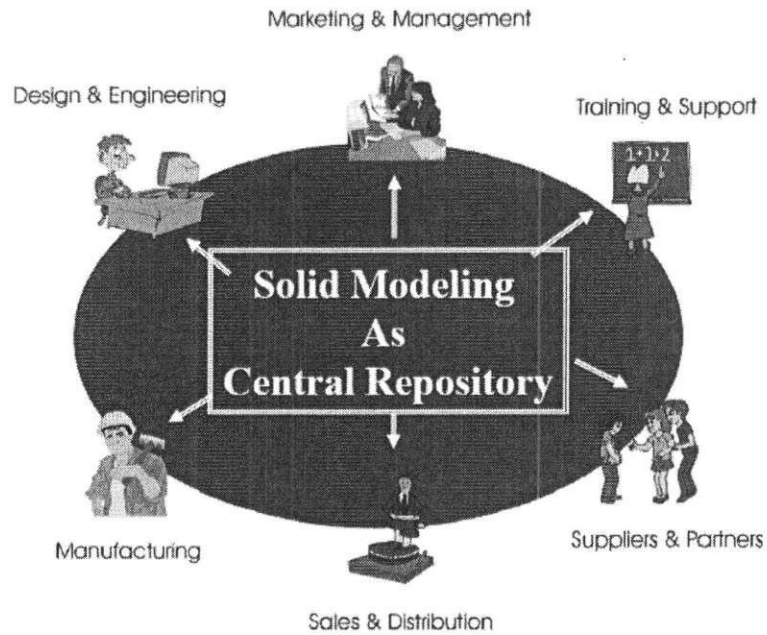


Concurrent Engineering

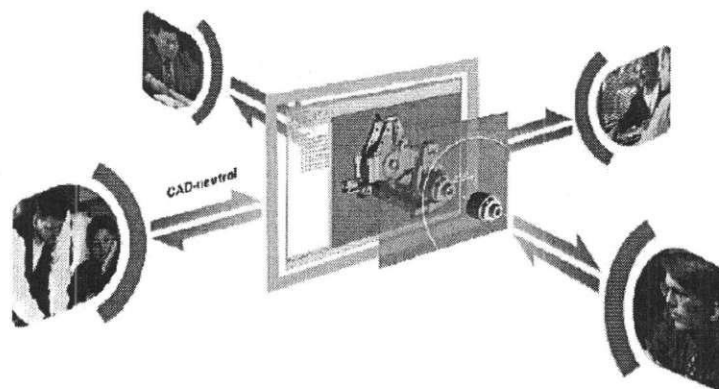


- A system approach to integrate and optimize design/analysis/manufacture processing
- Simultaneous processing instead of separate and sequential
- Single-data base instead of multi-data base
- 3D multimedia data transferring and representation instead of 2D drawing communication

Concurrent Engineering

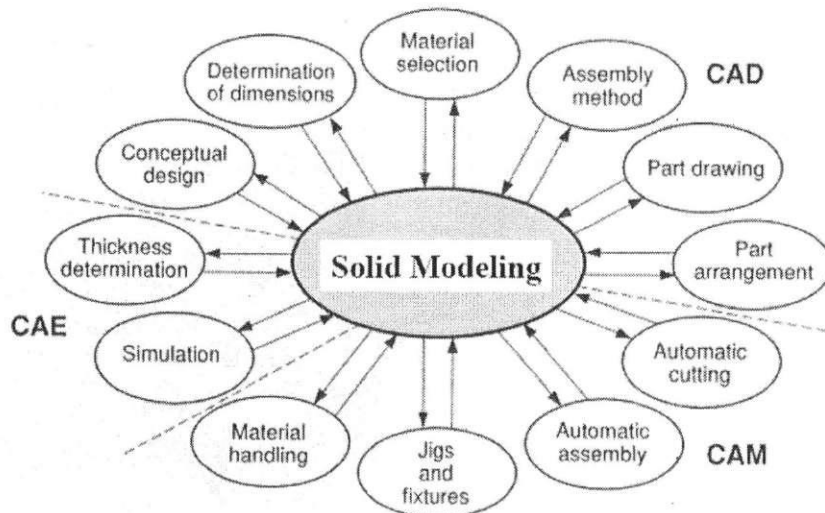


CAD as a Published Medium to promote on-line engineering collaboration

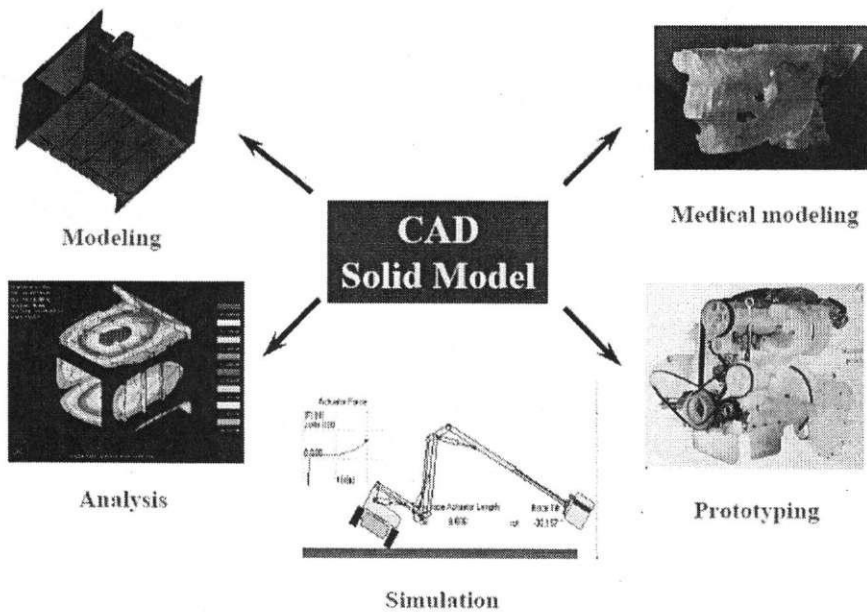


Advantage: real-time collaboration, effective, ownership
Disadvantage: CAD data transfer/speed

Role of CAD in Product Development Process

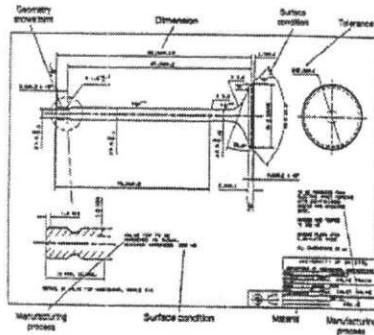


Solid Modeling Based CAD/CAE/CAM Integration

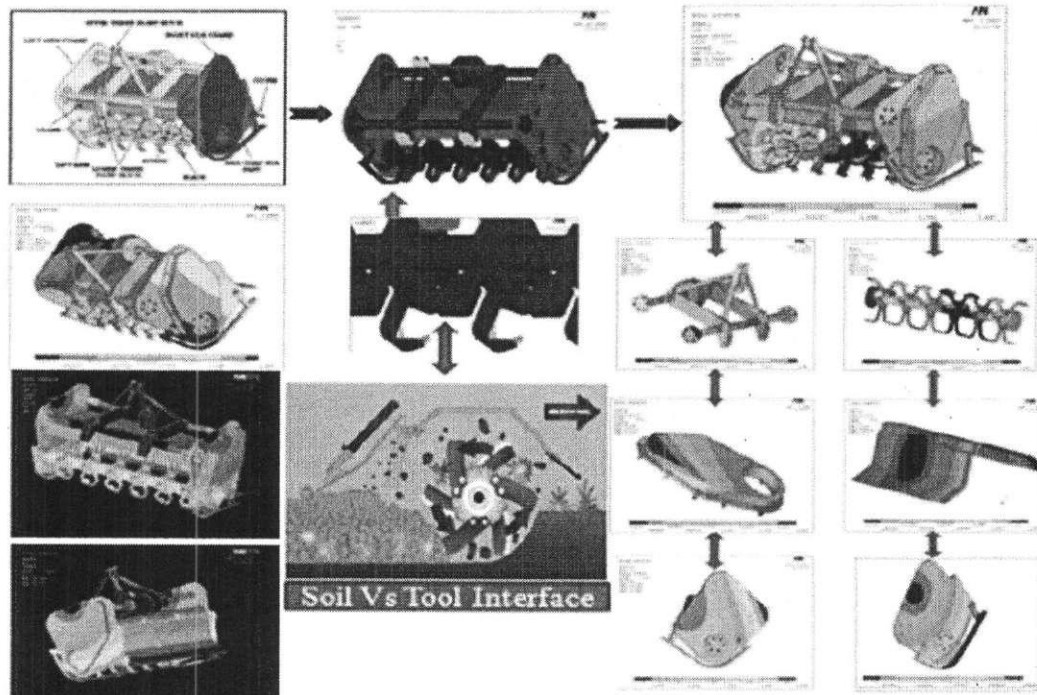
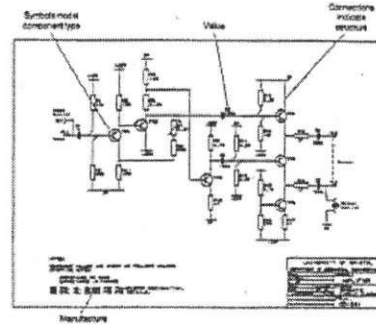


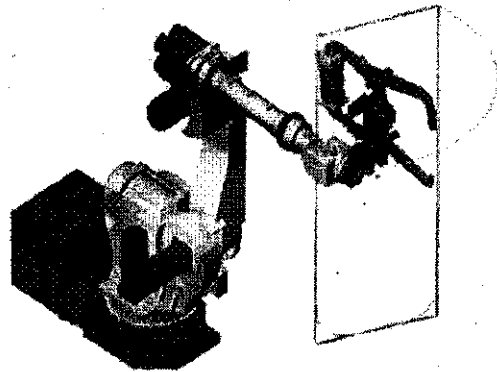
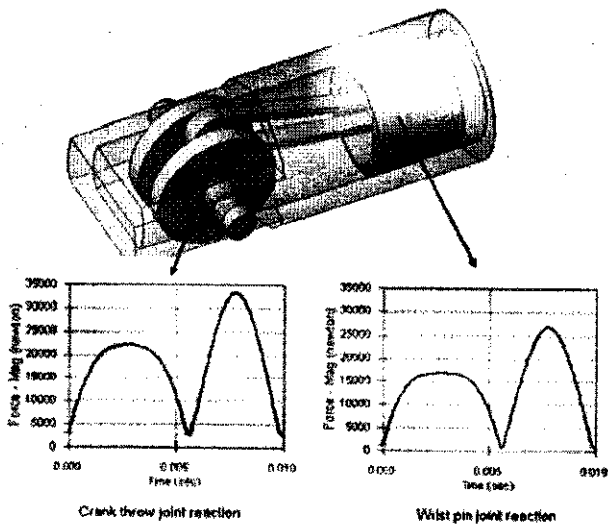
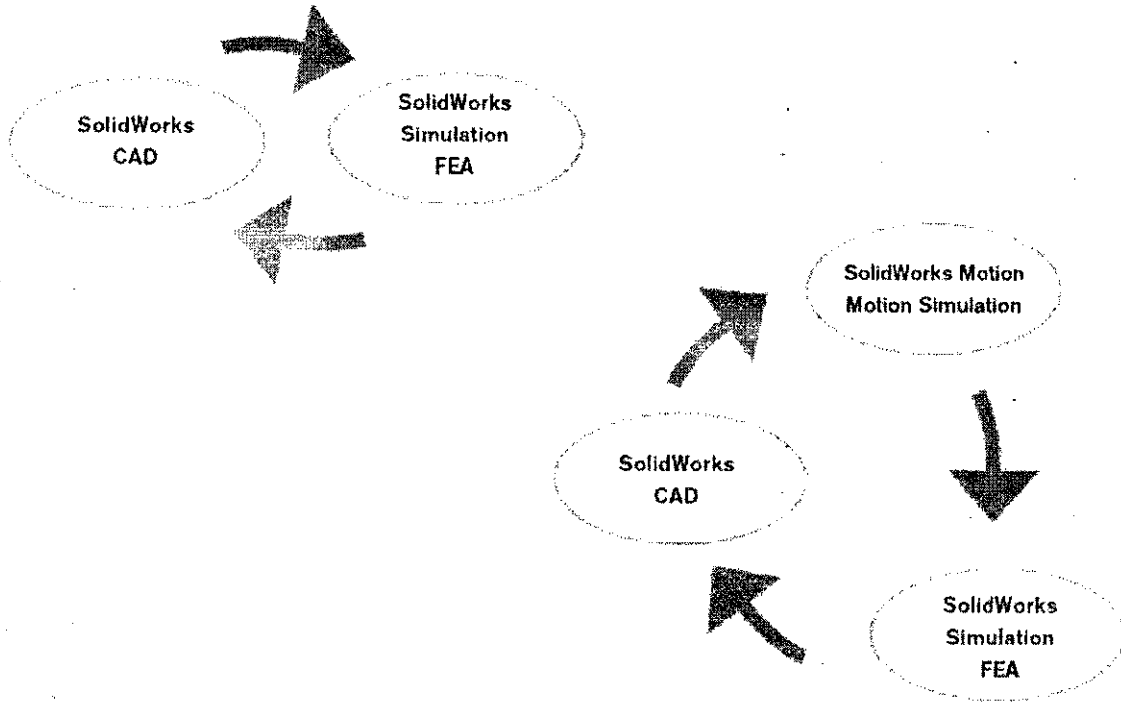
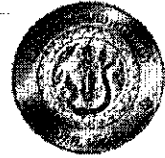
Representation of Design Model

By drawing



By diagram





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