MATHEMATISCHE TECHNOLOGIE

MATEUM

UNIVERSITEIT MAASTRICHT

Modelling and Optimizing the Health Chain

Introduction Theme 3

Joris van de Klundert
(Mateum/Maastricht University)

Motto

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

World Health Organization, 1999:

'One of the most important roles of the World Health Organization is to assist countries in making optimum use of scarce health care resources'.

Mathematics are like pills.....

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

.....Not always pleasant to take, but sometimes necessary

Talk & Theme outline: OR & integrated decision making in health care...see whether mathematical pills can cure health chain illnesses.....

Let's start by investigating the contribution of mathematical modelling and optimization in related areas: value chains...

Porter: Strategy in value chains

MATHEMATISCHE TECHNOLOGIE
MαTEUM
UNIVERSITEIT MAASTRICHT

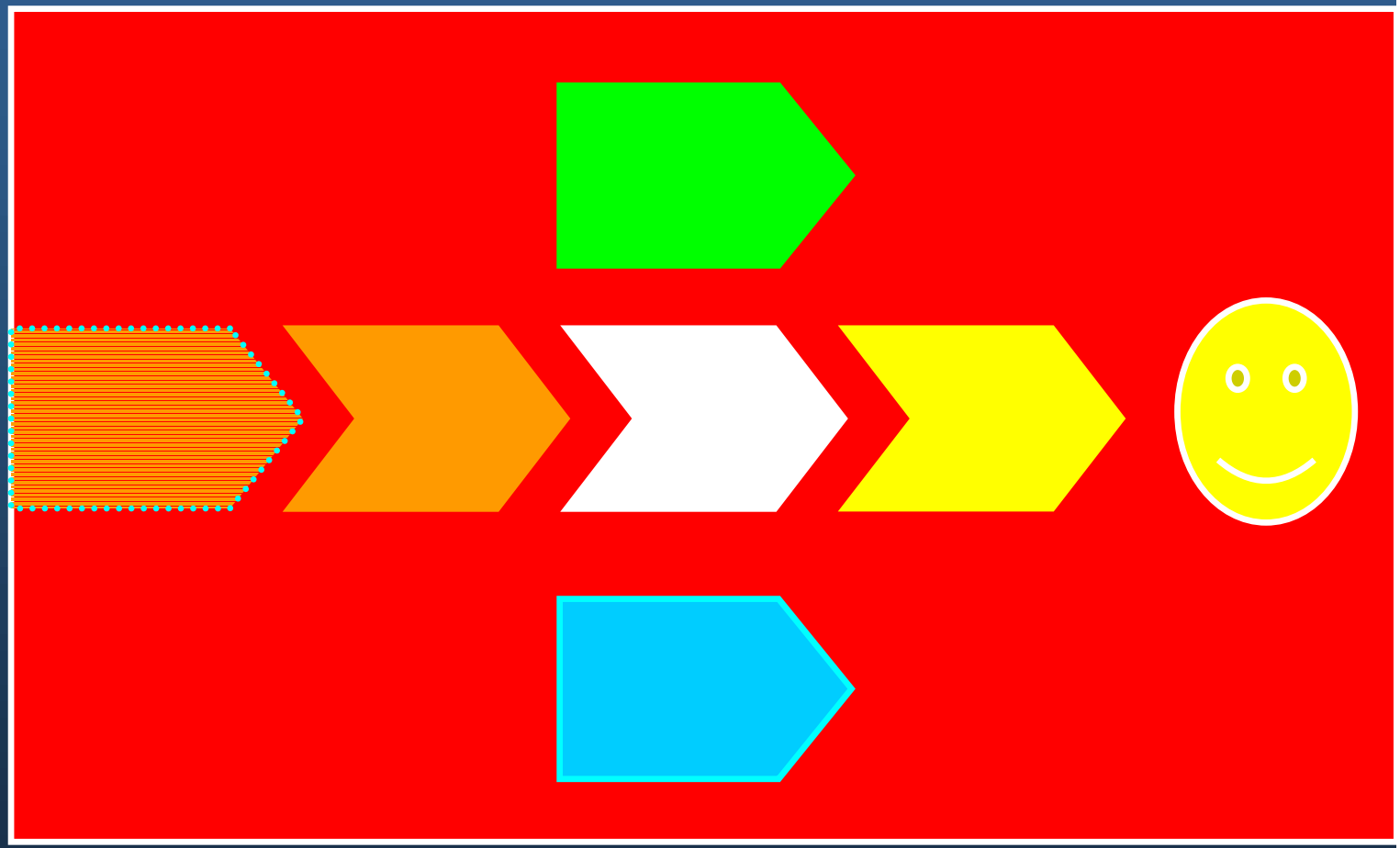
Create value....

Bring a product or service to the market which is worth more to the customer than it costs to produce - and which cannot be copied easily by competitors

....through sustainable competitive advantage

Porter's forces of the environment

- Government
- Suppliers
- Competitors
- Substitutes
- Customers



In the end, competition is by chains, not by individual firms

Modelling and optimization

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

- Ultimately, optimization must regard value, customer value, and/or shareholder value

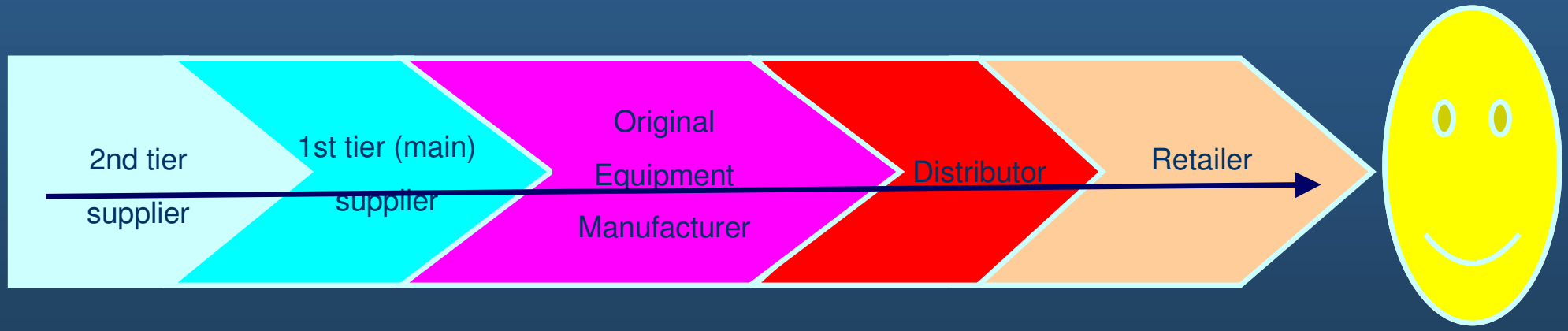
- Other key performance indicators (KPI's) are derived. In many industries these KPI's are systematically understood (e.g. SCOR model) and can be modelled.

Example: offering the lowest price à producing at the lowest costs, à (among others) maximum capacity utilization.

Supply chain management

MATHEMATISCHE TECHNOLOGIE
MATEUM
UNIVERSITEIT MAASTRICHT

Ø Physical goods: mature, standardized, business processes



Ø Some firms have a huge sustainable advantage, and can dominate their supply chain: they implement supply chain management

Supply chain achievements of O.R.

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

- Supply network design
- Tactical planning (Demand planning)
- Production Scheduling
- Inventory Management
- Vehicle Routing (distribution logistics)
- .....

- Decision making problems are well understood at the company level, can usually be (mathematically) modelled
- Decision making problems can be solved by (mathematical) optimization tools (e.g. APS systems)
- At the chain level, collaborative optimization is still in its infancy.

(Medical?) supply chain KPI's

MATHEMATISCHE TECHNOLOGIE
MαTEUM
UNIVERSITEIT MAASTRICHT

- Capacity utilization

  Is 90% utilization for a manufacturer high or low?

  Is 90% for an emergency operating theatre in a hospital high or low?

- Supply chain lead time

  Is 30 days for a personal computer high or low?

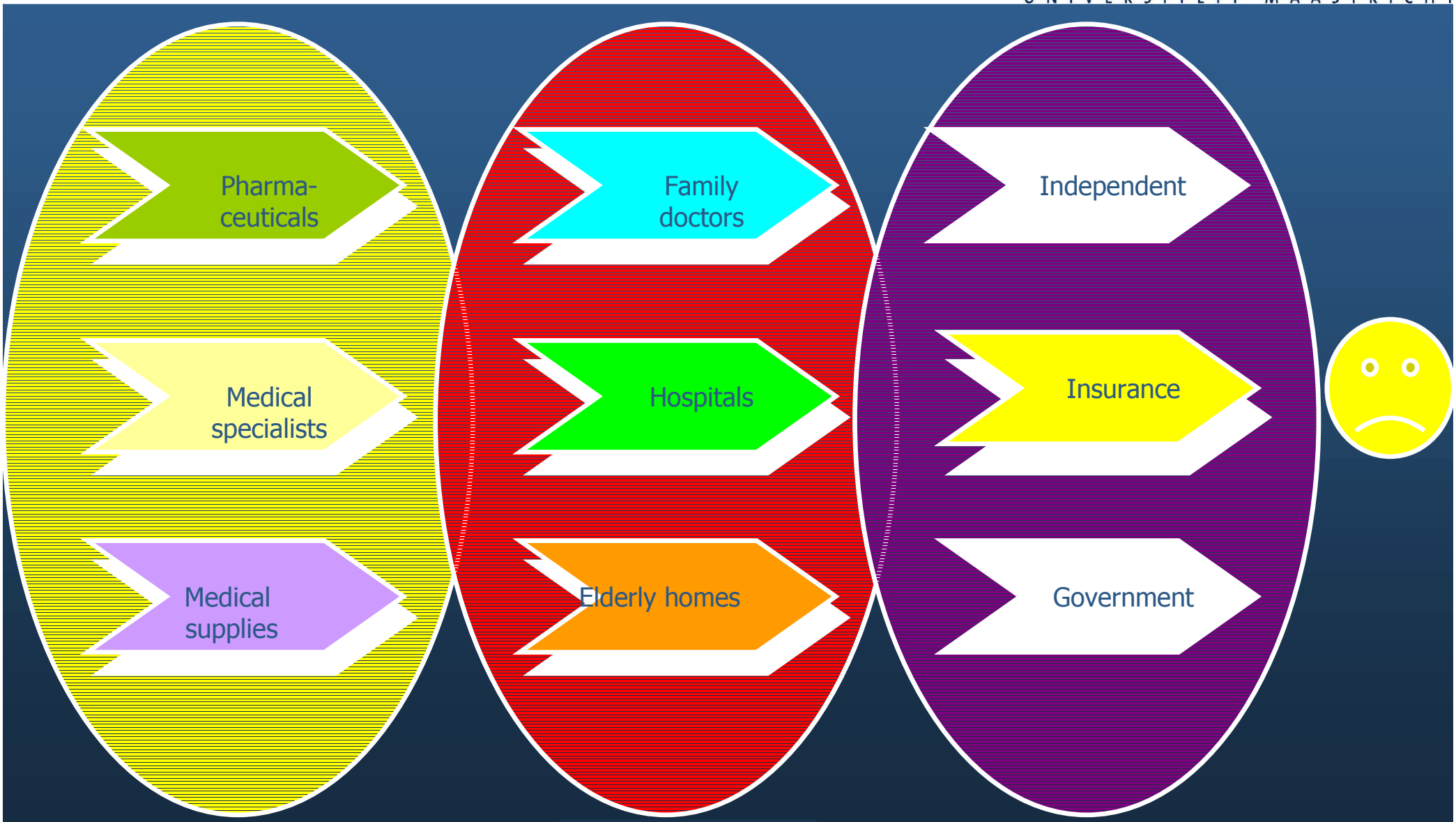
  Is 30 days for medicins or medical devices high or low?

O.R. in Service Value Chains

MATHEMATISCHE TECHNOLOGIE
MαTEUM
UNIVERSITEIT MAASTRICHT

- Yield/revenue management
- Financial optimization
- Customer service centre optimization
- Rostering/Time tabling
- Some decision making problems are well understood at the company level, and can be (mathematically) modelled
- Most such problems can be solved by (mathematical) optimization tools
- At the chain level, collaborative optimization is almost non existent.

The health chain



Health ≠ Value

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

- Ultimate KPI is health which is hard to quantify, especially in euro's.
- Customer health often depends in a complex way on joint efforts by various health chain partners
- Government is a very dominant player, setting rules (of competition) which hopefully entail that objectives (KPIs) of health care providers lead to customer health
- The better the health chain, the longer we live, the more costly the system

Consequences

MATHEMATISCHE TECHNOLOGIE

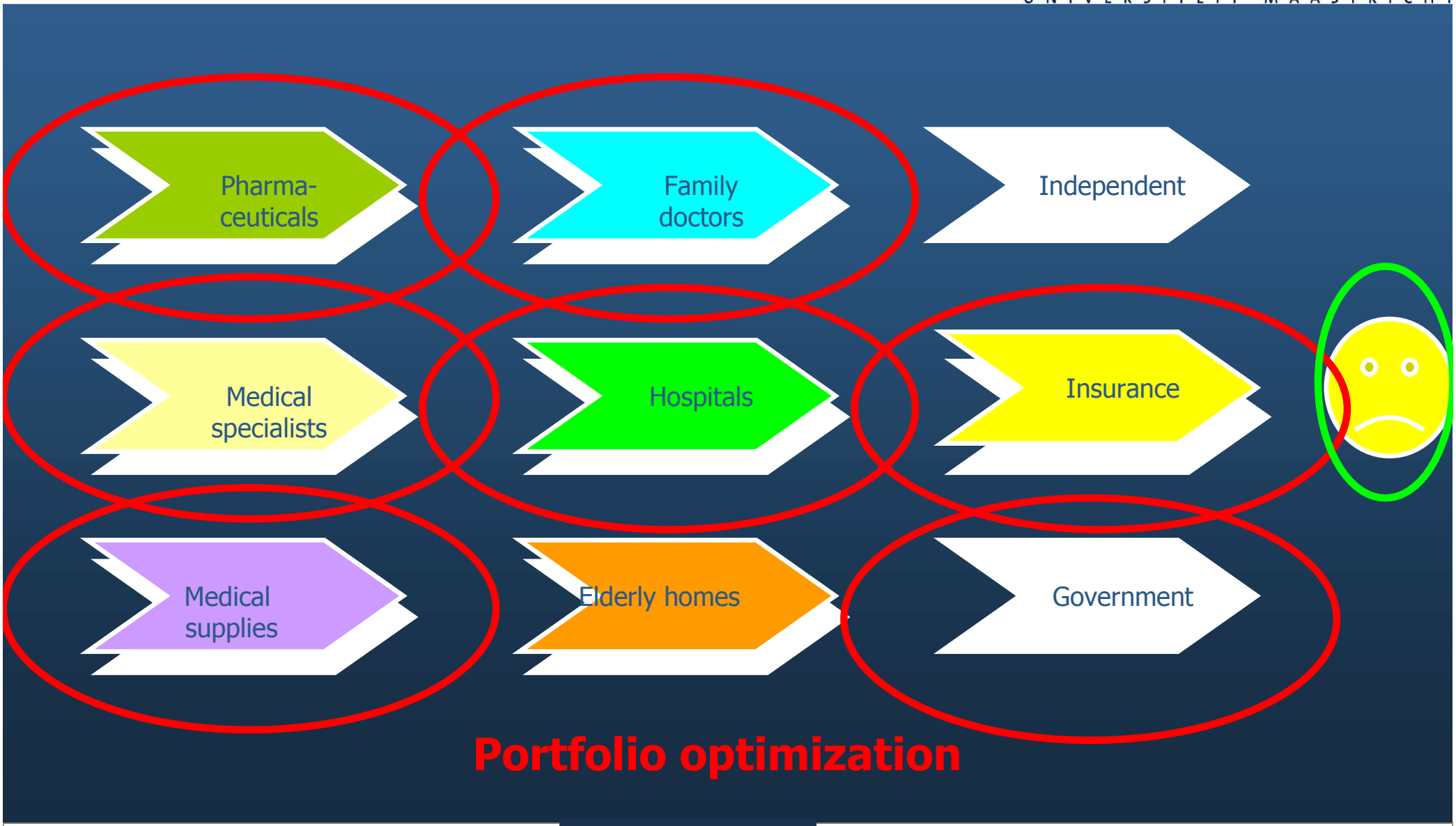
MαTEUM

UNIVERSITEIT MAASTRICHT

- From a goverment perspective:
  - model: understand the dynamics of the health chains,
  - set objectives: identify measurable customer health related KPIs
  - set budgets
  - set rules, such that health care providers act accordingly
- From a health care providers perspective
  - understand health chains and select a (market) strategy
  - translate the (market) strategy into KPI's
  - improve processes, also between health chain partners

Pills: Treatment portfolio selection

MATHEMATISCHE TECHNOLOGIE
MATEUM
UNIVERSITEIT MAASTRICHT



Work in this area

MATHEMATISCHE TECHNOLOGIE

MαTEUM

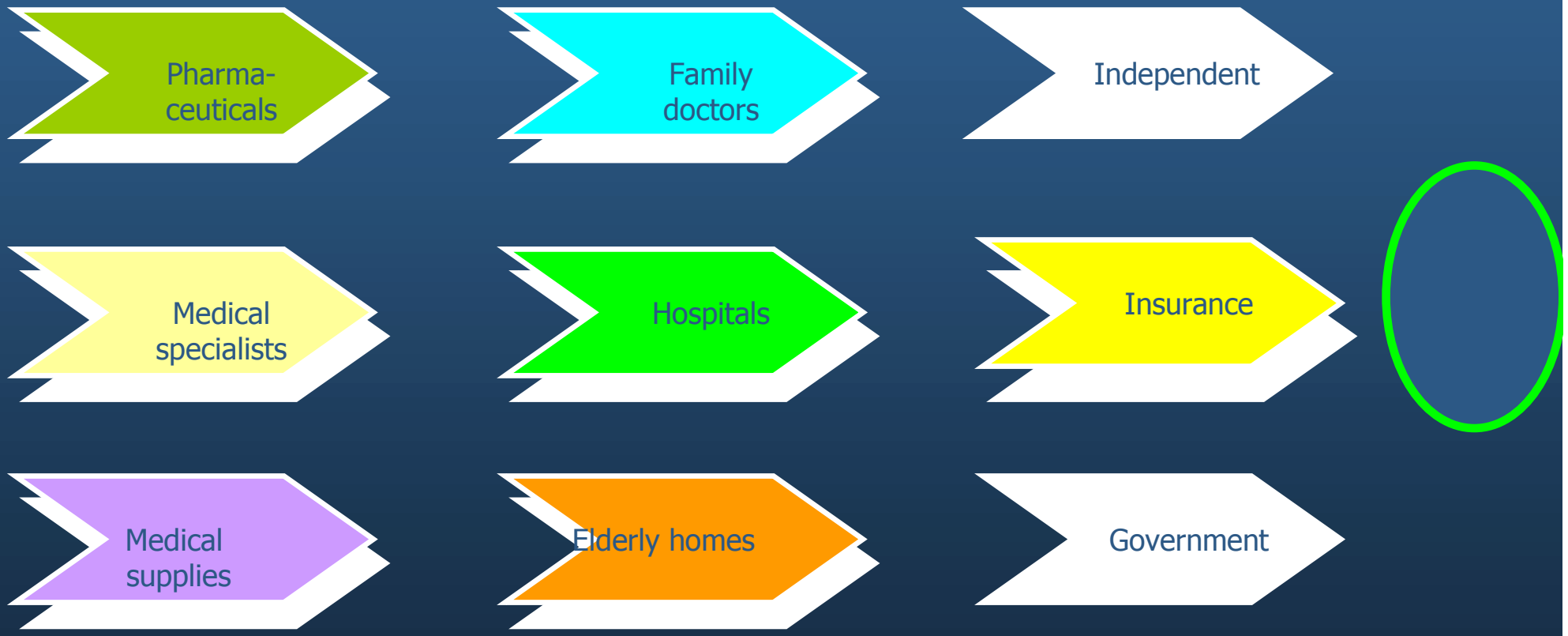
UNIVERSITEIT MAASTRICHT

Verburgh 1994

Little has been done in this area?

Pills : Health Chain Logistics

MATHEMATISCHE TECHNOLOGIE
MATEUM
UNIVERSITEIT MAASTRICHT



Supply network design / collaborative planning

Work in this area

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

Maarten Rutgers (speaker)

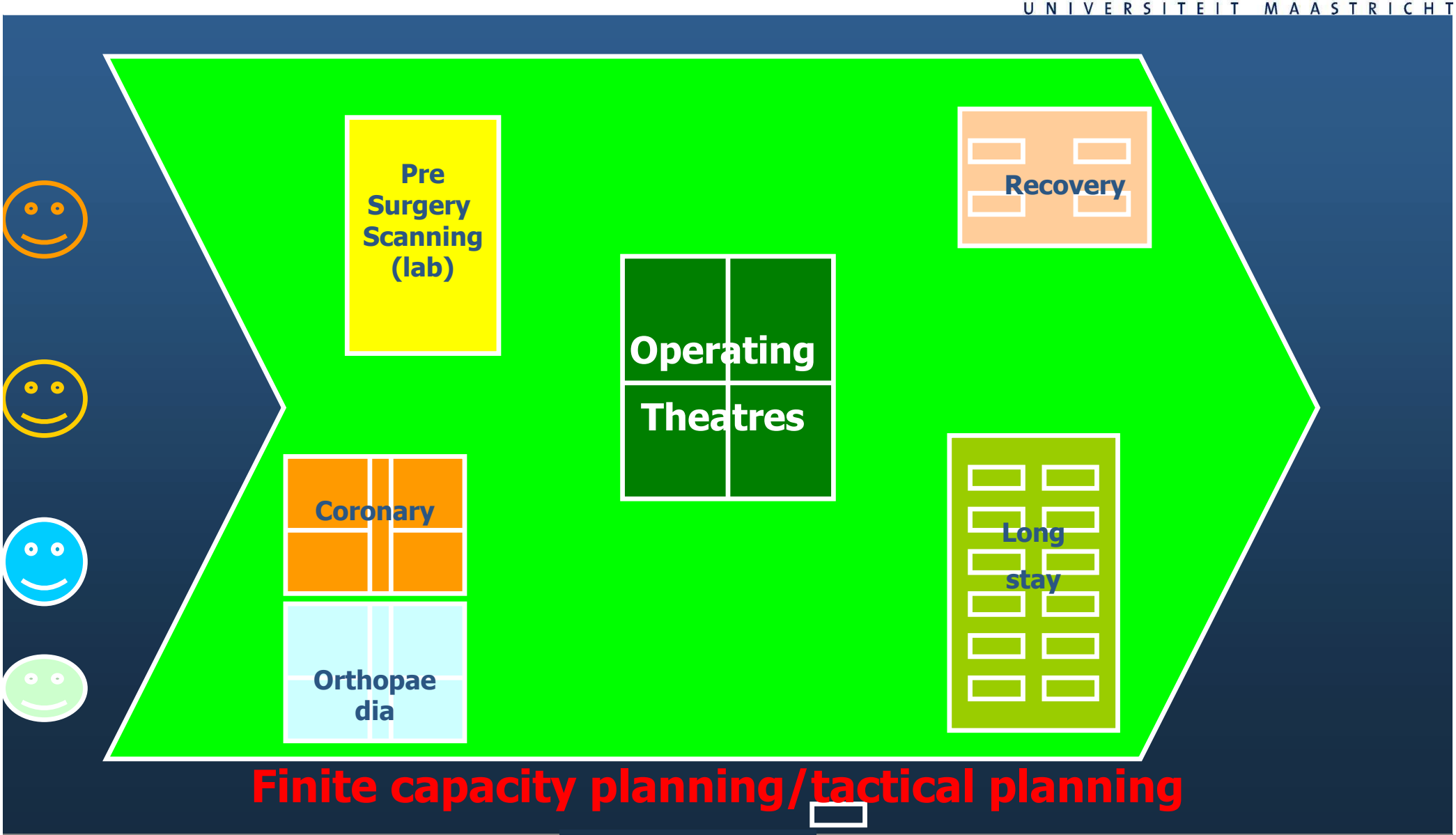
Ettiene Rouwette (speaker)

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

Pills : DRG mix optimization



Work in this area

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

Adan & Visser (2002)

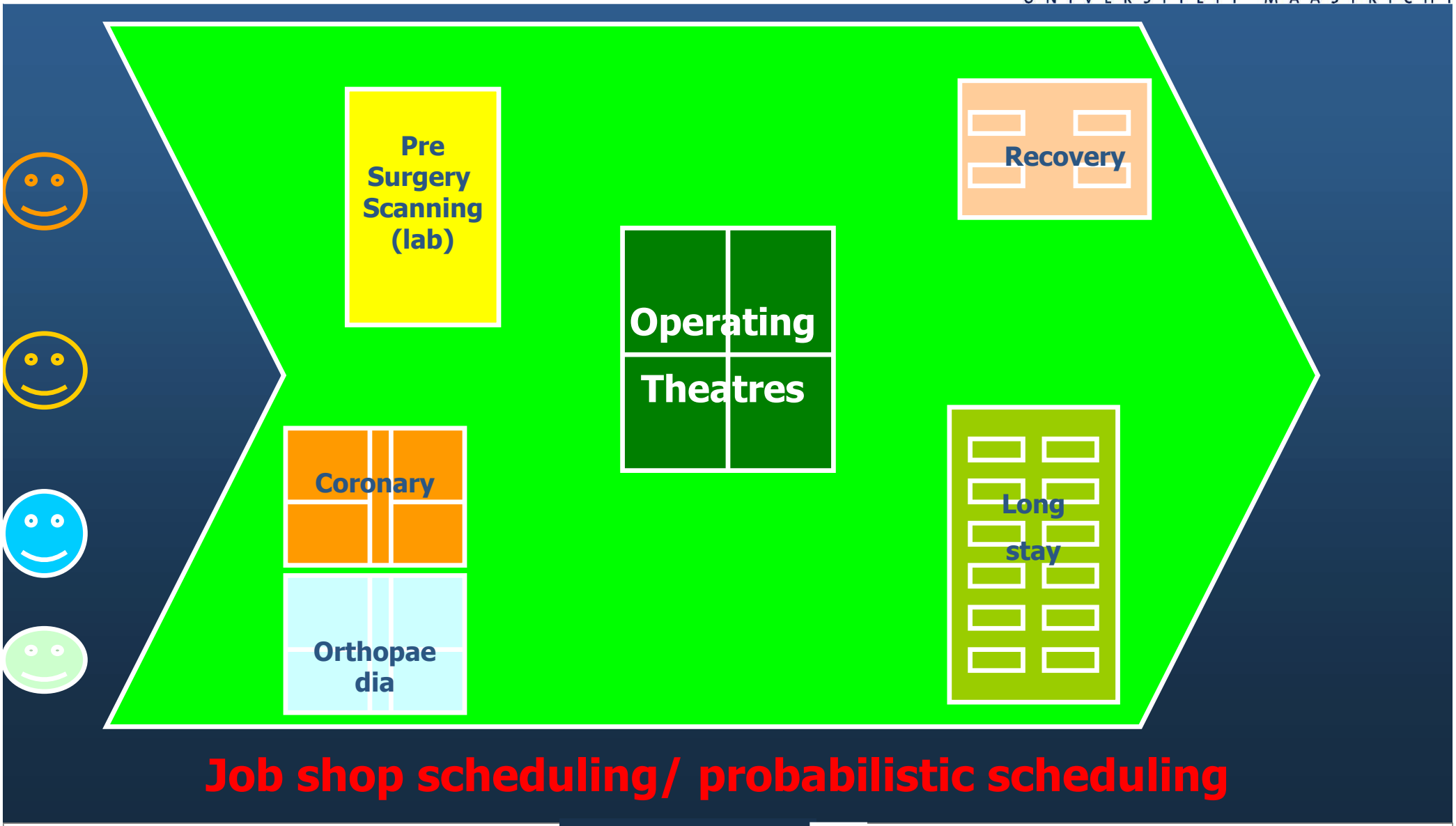
Opstal & Van de Klundert (2005)

Pills : Internal patient logistics

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT



Job shop scheduling/ probabilistic scheduling

Work in this area

MATHEMATISCHE TECHNOLOGIE

MαTEUM

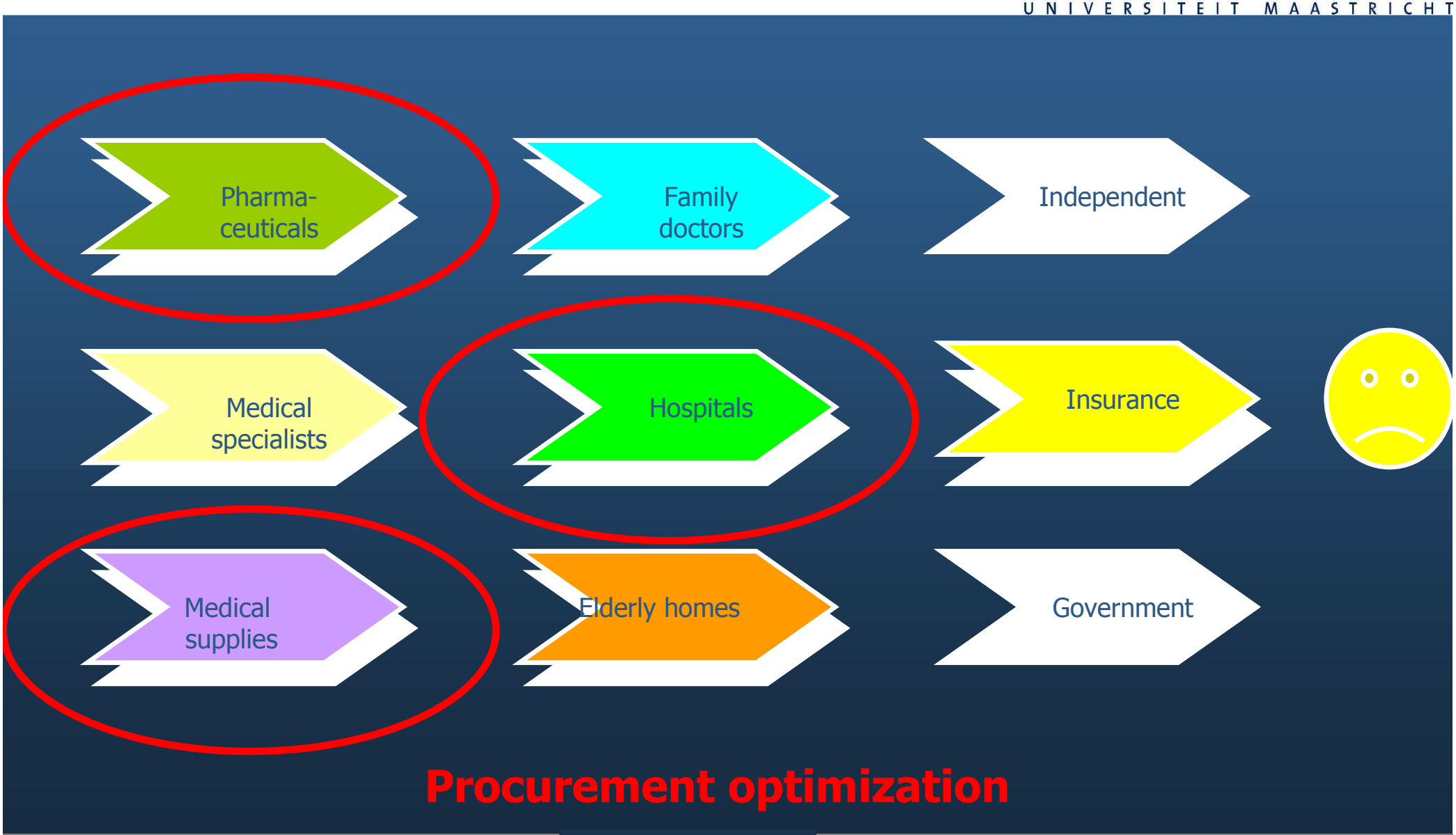
UNIVERSITEIT MAASTRICHT

Green, Savin, Wang (2003)

Commercial hospital planning tools are coming up....

Pills : Inbound logistics

MATHEMATISCHE TECHNOLOGIE
MATEUM
UNIVERSITEIT MAASTRICHT



Work in this area

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

Bakker (2003) (goods + pharma: 1 billion euro)

Goossens et al. (2005)

Van de Klundert et al. (2005)

effects on KPI's

MATHEMATISCHE TECHNOLOGIE

MαTEUM

UNIVERSITEIT MAASTRICHT

- Ø Reduced waiting times between health care providers
- Ø Reduced waiting times within health care providers
- Ø Reduced in process time, faster (= better) cure/care

- Ø Lower logistics costs
- Ø Higher capacity utilization

- Ø More health per euro