3.3 Propose a set of drivers and relationships to inputs

Before starting with an data analytics project and define the suitable methods, one have first to become clear about what is the input and what is to output function:

- One can do that **informally**, just by ``having it in mind"
- Or one can be more **formally** and again to write this down in sketches and diagrams.
- The later is preferred as this supports in the communication with the stakeholder
- If one can set up sketches and diagrams it is much easier to bring all stakeholder on the same page

3.3 Propose a set of drivers and relationships to inputs

Example:

Predictive Maintenance: A manufacturing company wants to predict the time points of machinery breakdowns and the optimal time point to perform the machinery maintenance before a breakdown occurs.

$\Rightarrow$ This is the output function

3.3 Propose a set of drivers and relationships to inputs

The inputs are elicited by information gathering from the stakeholders e.g. interviews or analyzing previous work performed:

- What future activities and changes are planed compared with today?
- What data are available? In what form are the data available?
- What is the production capacity of a machine? Are there planed changes?
- Are there different materials used?
- How often is a machinery broken down in the past?
- Why a machinery is broken down in the past? And at which time points?
- Are people with specialist skills required? How often? And what task are they performing?

3.3 Propose a set of drivers and relationships to inputs

Important:

At this stage you are not looking for causal relationship.

One is just collecting ideas for building up hypotheses against which you would like to test your model.

And when you have a summary of input and output functions one can draw simple graphs to discuss them with the stakeholder.

3.3 Propose a set of drivers and relationships to inputs

First graph: increasing factor or a decreasing factor

Example: Operating room processes in a hospital

E.g. One input is the changing and cleaning time of an operating room between two surgeries:

- If a surgery of a planned patient is following a surgery of a planned patient, then the time is 45 minutes
- If an emergency case is following the surgery of a planned patient or the surgery of a planned patient is following a surgery of an emergency, the changing and cleaning time is 60 minutes
- Thus, emergencies are an increasing factor to the changing and cleaning time of an operating room

3.3 Propose a set of drivers and relationships to inputs

First graph: increasing factor or a decreasing factor

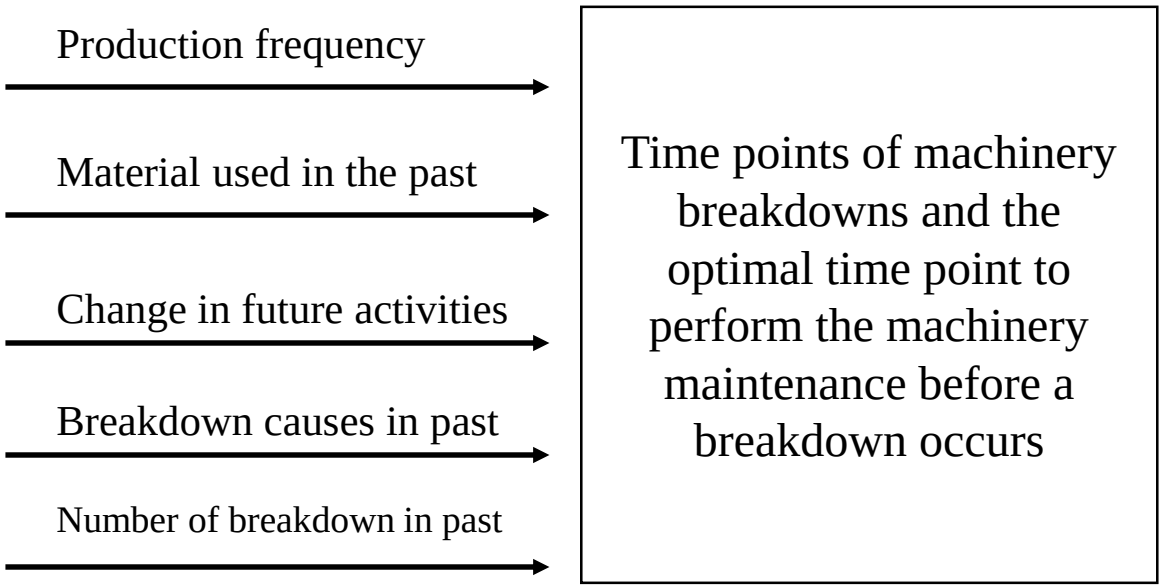
Example (cont'd):

Increasing factors		Decreasing factors	
Factor name	Scale (1-10)	Factor name	Scale (1-10)
Emergencies	7	Number of available operating rooms	2
Relative number of planned patients to the opening hours	2	Longer opening hours of the operating room	4
Variability in the length of an surgery	5	Available surgeons	1
…		Available staff	2
		…	

3.3 Propose a set of drivers and relationships to inputs

Second, a so-called black-box sketch

Example: Predictive Maintenance



3.3 Propose a set of drivers and relationships to inputs

- The idea is to make the input visible such that it can be discussed and challenged by people who have the technical expertise but not necessarily the data analytics expertise
- Nevertheless, these work outs are only estimates and subject to changes depending on what reality turns out to be
- To draw the inputs in graphics and discussing them and challenging them also in later stages prevent us in hanging on to views what we have seen before even if they are wrong
- Thus, a regular re-questioning and re-challenging helps in not stick to much on one's believe.

3.4 State the set of assumptions related to the problem

In each and every input factor as well as output, there are one or more assumption embedded.

Often in organisations one has common practice assumptions which are often nowhere stated nor in writing.

It is important that in a project **all** assumptions are listed and assessed i.e. an assessment of the influence of this assumption.

3.4 State the set of assumptions related to the problem

Example: Hospital optimisation

3 Boundary of model and assumptions

The model will only include [UNIT A] and Main operating room units, and not include any other facilities, such as inpatient or service units.

3.1 Main OR's

Current state

The model will include all 25 OR's where 15 are dedicated to the following service lines:

- 4 Cardiac rooms
- 4 Neuro rooms
- 4 Ortho rooms
- 1 Trauma / urgent room
- 2 Transplant rooms (1 for livers, and 1 for urgent trauma)

+ 3 Cysto room (in addition to the 24)

-

+ 8 OR's in the new Heart Center 4

The following will not be included in the simulation model:

- 3 Ophthalmology rooms
- 1 Breast room (in addition to the 24)
- Eye Institute

- Main OR Suites are designated to specialties
- Current block time scheduling determine OR suite usage
  - All blocks are assigned by service line (1st driver)
    - Then some blocks are assigned by surgeon (2nd driver). The same surgeon get the same time each month and have generally the same schedule
    - Block time in true monthly basis (some weeks have 4 weeks and some weeks have 5)
    - Block time is the same unless a surgeon leave
- 1 OR suite per service line except the following, which can have 2 OR's:
  - Ortho
  - Cardiac
- Limitations:
  - Robot room 31(same day): cases:
- Cases per day:
  - No set number, just go by time as long as a case does not go passed the 7pm cut off time.

Future state

- The current block schedule will be utilized to measure future block time requirements per surgeon.
- Future block schedule in the new Heart Center will determine which days a block is freed up in the current block schedule, if any.
- Max number of cases per OR suite per day: No constraint other than time (opening hours).
- 1 OR suite per service line except the following, which can have 2:
  - Ortho
  - Cardiac
- Future state scenario 1 will relocate as many ambulatory cases as possible that will fit into the new OR's and leave pure inpatient and emergency cases in general OR's. Main OR driver will be current block schedule.
- Future state scenario 2 will relocate as many ambulatory cases as possible that will fit into the new OR's and leave pure inpatient and emergency cases in general OR's, as well as improve turnover time. Main OR driver will be current block schedule.
- Future state scenario 3 will test scenario 1 and 2 including patient volume growth rates
- Utilization measured by hours available per OR suite / hours utilized. Main OR driver will be current block schedule.
- OR suite utilization measured by hours available per OR suite / hours utilized.
- Block time utilization will be measured by hours utilized / hours assigned
- Turnaround time (TAT) measured by: previous case out of OR suite-> next case into OR suite.

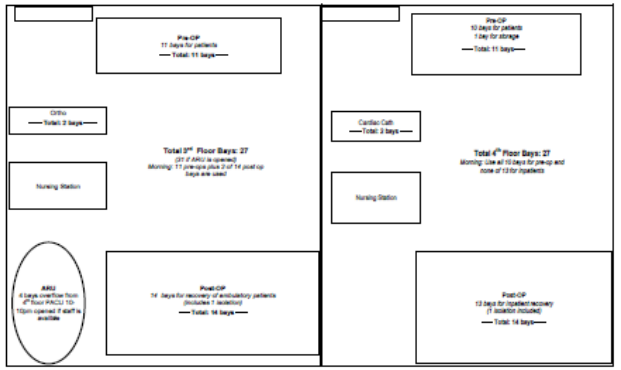
- TAT will be excluded for incidents >70 minutes, as over 70 minutes is for cases that start after 5pm or cases performed during the weekend.
- "Close-to-Incision" time measured by Incision stop- next Incision start.

- Opening hours:
  - 3rd floor: 6.30 am – 10.30 pm
  - ARU: 3-5 days a week (10 am – 10 pm)
  - 4th floor: 6.30 am – 10 pm (pre OP), 24 hours (post OP)
- Prioritization rules:
  - First come, first serve to pre OP and post OP except:
    - Only Ortho and Cardio to 2+2 bays in pre OP
- Utilization measured by hours available per bay / hours utilized

3.3 Pre OP and Post OP

Current state

- Pre OP capacity:
  - Pre OP 3rd floor (ambulatory): 11 bays +2 Ortho
    - Morning: + 2 of 14 post OP bays
  - Pre OP 4th floor (inpatients): 10 bays for patients + 1 bay (used for storage) + 2 Cardiothoracic bays
- Post OP capacity:
  - Post OP 3rd floor (ambulatory): 14 bays for ambulatory patients
    - 1 isolation bay included
  - ARU Overflow area (3rd floor): 4 bays overflow from 4th floor post OP
  - Post OP 4th floor (inpatients): 13 bays for inpatient recovery (- 7 to 10 overlay patients per day)
    - 1 isolation bay included



3.5 Define key metrics of good performance

Important: it has to be measured

Examples:

- Revenues have to be improved by X%
- No net loss of customers
- The production process has to be Y minutes faster per quantity
- Sales per customer has to be increased
- The travel time of passenger has to be shorten by Z minutes
- ….

3.5 Define key metrics of good performance

Measures can also be combined:

Examples: Hospital simulation

- The utilization of the operating rooms have to be improved

AND

- The waiting time of the patients should not be significant longer

3.6 Obtain stakeholder agreement on the approach

This can be either separated from the business problem statement or integrated:

[CLIENT]

Model Design Documentation

7.10.2015 H. Meier

….. ……

(date) (signature)