Economic Analysis

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Mapping Energy Value Stream

- ✓ Value stream encompasses all activities creating values
- ✓ Scope of value stream: Entire process
- ✓ End activity: A Customer
- ✓ Objects in the value stream: materials, components, people, money, information, etc.

Mapping Energy Value Stream

Types of value stream maps based on the flow:
- ✓ Material
- ✓ Information

Types of value stream maps based on the time and objectives:
- ✓ Current conditions
- ✓ Ideal state
- ✓ Future state (e.g., 3-6 months from now)

Mapping Energy Value Stream

Purpose of value map:
- ✓ Communicate
- ✓ Discover waste
- ✓ Identifying sources of waste
- ✓ Plan actions to eliminate the waste

Mapping Energy Value Stream

Analyzing value based on the value map:
- ✓ Who is the end-customer?
- ✓ What value do customers buy?
- ✓ What stream of activities leads to this value?

Mapping Energy Value Stream

- ✓ Value stream maps of importance
- ✓ Commonality with the process modeling methodologies

Turbine Installation Cost

- ✓ Installation costs include a foundation, normally made of reinforced concrete, road construction (necessary to move the turbine and the sections of the tower to the building site), a transformer (necessary to convert the low voltage (e.g., 475 V) current from the turbine to, e.g., 10-30 kV current for the local electrical grid, telephone connection for remote control and surveillance of the turbine, and cabling costs, i.e., the cable from the turbine to the local 10-30 kV power line

Installation Costs Differ

- ✓ The cost of roads and foundations depends on soil conditions, i.e., building a road capable of carrying all turbine components
- ✓ Distance to the nearest highway
- ✓ The cost of getting a mobile crane to the site
- ✓ The distance to a power line suited to handle the turbine power
- ✓ Transportation costs of all turbine components can not be ignored
- ✓ An Internet connection and remote control center is necessary, however, the cost is usually low

Economies of Scale

- ✓ Connecting many turbines in the same location offers cost advantages
- ✓ Yet, the electric grid limits to the amount of power it can handle
- ✓ The grid may need to be reinforced, e.g., the high voltage electrical grid need to be extended
- ✓ Numerous parties may be involved in the grid modification, which is usually location (e.g., state) dependent

Operation and Maintenance Costs for Wind Turbines

- ✓ Wind turbines are designed to operate for 120,000 + hours over the design lifetime of 20 + years
- ✓ Data shows that maintenance cost is typically low for new turbines and it increases as the turbines age (which is natural)
- ✓ The terms of maintenance contacts vary, form fixed annual cost to the cost per service performed (expect growing competition in this area)

Economies of Scale

- ✓ Besides the economy of size of an individual turbine, the wind park economy of scale is of importance
- ✓ The economy of scale benefits stem from maintenance, administration, and so on
- ✓ This is particularly true for rotor blades and gearboxes that may be overhauled in batches rather than individually
- ✓ The price of a new set of rotor blades, a gearbox, or a generator may be in the order of magnitude of 15-20 % of the price of the turbine

Turbine Design Lifetime

- ✓ Wind turbines are usually designed to last, e.g., 20 - 25 years
- ✓ Designing components to last longer might be a waste
- ✓ The designed lifetime, e.g., 20 - 25 years, needs to be carefully evaluated as it impacts the individual system and component design/selection
- ✓ The actual lifetime of a wind turbine depends both on the quality of the turbine and the local climatic conditions, e.g., turbulence at the site
- ✓ Offshore turbines may last longer, due to lower turbulence at seas