RAMBOLL

SPARK PROBLEM STATEMENT SAMPLES

SAMPLE 1: ADVANCED MANUFACTURING FOCUS

THE SMART MANUFACTURING REVOLUTION GETS DOWN TO BUSINESS

CHALLENGE

"Established high tech manufacturers are just starting to explore the application of advanced digital technologies to increase competitive advantage (Smart Manufacturing). The explosion of data from sensors, automated systems, Internet transactions and process workflows are forcing manufacturers to rethink their mature organizational structures and operating mechanisms to derive new sources of value.

Teams are challenged to identify the organizational impact of technologies with most potential to drive disruptive value creation. They should look for opportunities to stimulate new thinking inside established companies and outline strategies for companies to adapt.

Solutions should be focused on how companies must adapt human resource systems including recruiting, employee training, organizational structure, manufacturing/development tools or operating metrics to name a few. External factors can be part of the solution, such as collaborative development of university programs or partnerships with symbiotic organizations. Recommendations must be action oriented and targeted at the biggest gaps that Smart Manufacturing technologies are likely to expose."

BACKGROUND

In the past decade, the ubiquity of information and the sophistication of analytics and automated systems has given rise to new commercial opportunities. For instance, advanced sensor technology now allows the development of digital twins; computer-based representations of physical parts that can be used to drive higher product performance. Part tracking systems can be combined with sophisticated scheduling algorithms to guide prioritization of production events and assure on time delivery.

The revolutionary emergence of Smart Manufacturing technologies ("Cloud", "Big Data", "Internet of Things", etc.) is spreading rapidly and companies are rushing to update their data management operations to leverage data for competitive gain. Companies are looking at developing analytics to pore through large data sets and identify opportunities to reduce costs, improve quality, utilize assets more fully, and enhance customer service. The opportunities for improvement are outpacing the ability of companies to respond.

As companies begin to develop strategies for exploiting pervasive data and analytics, they are starting to see gaps in their operational structures. Many leaders who are mid- to late-career grew up during a time when information was not as prevalent. Legacy equipment and information systems weren't always designed with the flexibility needed to communicate the right data at the right time to achieve higher productivity or product performance.

This tapestry of opportunity is coming together in what pundits are calling Smart Manufacturing in the US (Industry 4.0 in Europe, China 2025, India Competes, etc.). These Government sponsored efforts represent a recognition that we are looking at a fundamental shift in how businesses will manage and utilize their data, causing shifts in every nation's industrial core. Companies that win in this new

environment will adapt their human resource systems quickly. Learning how to adapt is the subject of this challenge.

CONSIDERATIONS

When developing solutions, consider the following:

- The workforce is changing. Millennials are being hired by managers that, in many cases, understand less about information technologies than they do. And job mobility is increasing, meaning that solutions must be implemented faster and more effectively as ownership for initiatives may have to change hands frequently.
- University programs are beginning to offer new programs to support SMART Manufacturing, but more needs to be done to ensure that graduates bring more than computer skills to their new employers. They need to understand the connection between digital technologies and business results.
- Many equipment suppliers are far behind the needs of their industrial customers who seek to have dense monitoring of equipment condition, process parameters, and the ability to communicate that information to systems capable of the aggregation and analysis needed to turn data into actionable knowledge.
- Financial planning horizons are typically longer than many of the data analytics projects. In fact, the waterfall concept of engineering (and financial support) may not even make sense for some of the new technologies being implemented in factories.
- Access to information allows business people to ask better questions and get better answers about their operations, ultimately this enables process understanding and optimization.
- Think about how the Internet Revolution has changed consumer expectations around how we will carry out our daily data exchanges (banking, purchasing, collecting information, etc…). Think about how your own execution on this challenge is different from what it would have looked like in the past. What skills and technologies need to be leveraged to meet your own expectations around 'easy access' to information… and what do organizations that can deliver those systems need to look like.

DELIVERABLE

Solutions to this challenge must be actionable by leadership. The solution should be presented in the form of recommendations with data or logic to back each recommendation. Teams are encouraged to consider the leadership audience and how they must incorporate recommendations into their existing operations.

Where possible, teams should use examples to convey the potential of their solutions and employ graphs, schematics, flowcharts or images to more effectively convey their ideas. The best examples will be ones that involve experiences of team members or anecdotes from industry.

Teams are encouraged to apply creativity to this problem. There are innumerable ways in which data and analytics can impact human behaviors. The problem statement is not intended to confine thinking to any one area. Rather, it seeks to broaden thinking on how organizations should leverage its employee assets – from the perspective of students who will soon be entering the workforce and driving many of these new initiatives.

SAMPLE 2: ENERGY FOCUS

RESOLVING THE UNINTENDED CONSEQUENCES OF GRID MODERNIZATION AS WE TRANSITION FROM TRADITIONAL TO CLEAN POWER RESOURCES

CHALLENGE

The challenge is to resolve a thermal constraint(s) on an electrical power system. Under a given dispatch condition (which will be provided) a utility is experiencing thermal issues on the system's lower voltage networks under N-1 contingencies conditions. The solution should provide recommended system changes to eliminate the maximum number of thermal issues, identified under the N-1 contingency analysis, for the minimum cost.

BACKGROUND

A minimum number of 3 students per team should be a 3rd year EE (or Physics) or higher.

CONSIDERATIONS

The utility will supply a 1-line with all relevant system topology and dispatch information for the subject system to be evaluated.

DELIVERABLE

1. Solutions are to be provided in PowerWorld for system studies.
    a. Free software could be found at https://www.powerworld.com/download-purchase/demo-software
2. Study conclusions should include the following minimum requirements:
    a. N-1 Contingency Analysis
    b. Recommended solutions
    c. Alternatives Considered
    d. Minimal ratepayer impact

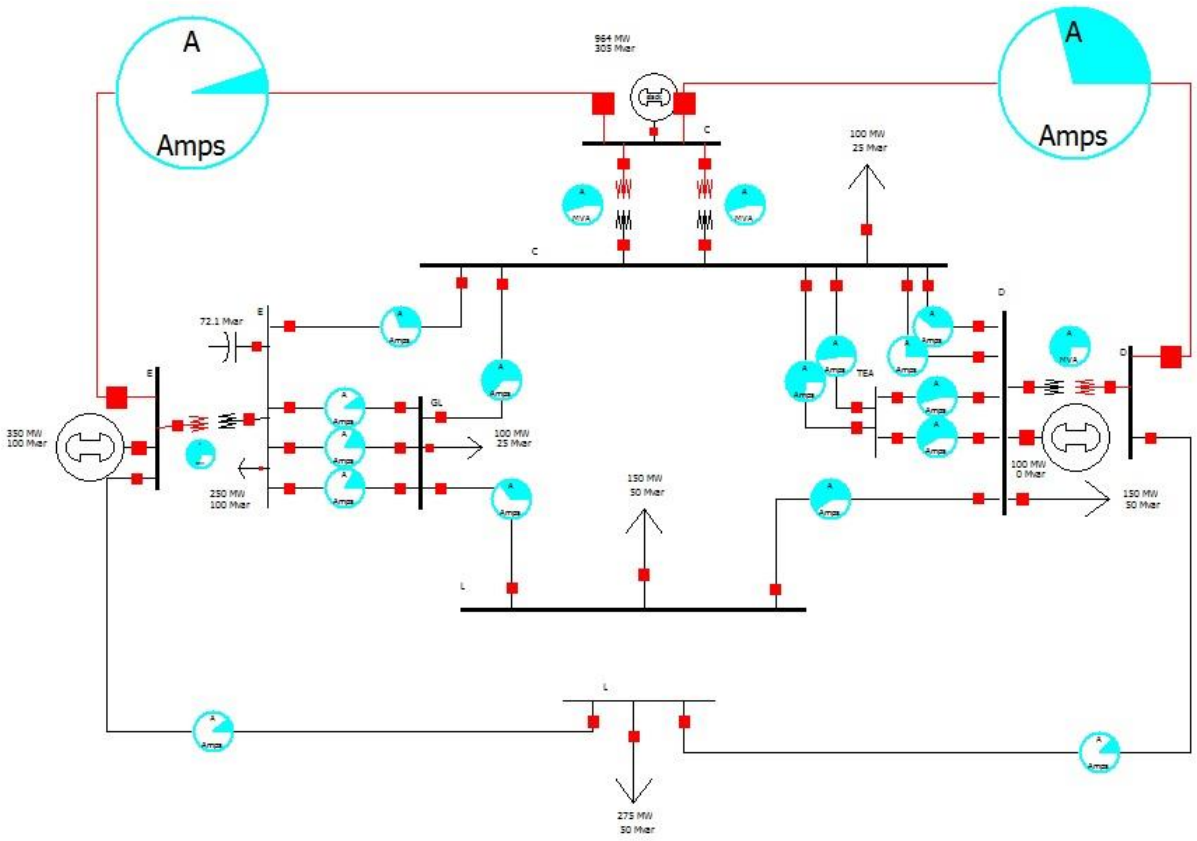

Figure 1. System Single Line Diagram

Table 1. Transmission Line Information

Voltage (kV)	Purpose	R (per mile)	X (per mile)	B (per mile)	Rating (MVA)	Cost ($/mile)
115	New Conductor	0.00090	0.00543	0.00078	250	3 M
115	Reconductor	0.00090	0.00543	0.00078	250	2 M
345	New Conductor	0.00010	0.00069	0.00612	1500	10 M
345	Reconductor	0.00010	0.00069	0.00612	1500	10 M

Table 2. Component Cost

Component	Cost ($)
Transformer installation (345-115kV)	10 M
Ring Bus Substation	7.5 M
Series Reactor	2 M
Series Cap Bank	20 M
Shunt Cap Bank	2 M
Breakers 345 kV	1 M
Breakers 115 kV	750 k

SAMPLE 3: ENVIRONMENT FOCUS

REMOTE WIDE-AREA WATER QUALITY SURVEILLANCE

CHALLENGE

The challenge is to develop a fully autonomous solution for monitoring water bodies in remote regions. The system should be capable of remotely monitoring a number of ponds on a frequent basis. The system also must be capable of collecting water samples from the remote ponds on demand, returning the samples to a base station, located about four miles away.

BACKGROUND

Area Z is a very remote region of approximately two square miles in area, surrounded by a large area of dense forest. Within Area Z are numerous fresh water ponds, some of which are thought to contain contaminants harmful to local wildlife. The ponds are thought to be contaminated as there have been reports of fish kills and, occasionally, dead birds and small mammals in the vicinity. The toxicity of the compromised ponds may be highly variable and also periodic.

Containments in water bodies can be classified as physical, chemical, or biological. They can come from natural sources such as organic matter, disease-causing organisms, and volcanic ash. Human activity is also a major source of contamination. Human activity includes garbage and sewage that can pollute the land and water. Human activity can also include the use of pesticides and chemical poisons used to kill weeds and insects, which can seep into waterways. A21 is known to be a very remote area thought to have low human activity, such as an occasional hunter or fisherman. This adds to the mystery.

Scientists desire to remotely monitor the ponds to develop a detailed longitudinal study of the area. The data needed to help identify the source of the contamination includes water temperature, pH, dissolved oxygen, and conductivity (salinity). Other parameters may also be helpful.

Occasionally and on demand, the Scientists will need water samples to be drawn from one or more designated ponds. They would like to have an unmanned solution for the sample collection, with the samples returned back to the field station for further analysis.

CONSIDERATIONS

Monitoring of each pond will require you to select one or more sensors that can be delivered to the pond by an unmanned system of some sort (e.g., UAV). You will need to balance the need for small SWAP (size, weight and power) with the sensor capabilities and the payload capability of your chosen delivery platform. There are commercially available water sensors that should be considered. You will also need to account for communication protocols that allow for interrogating the sensors. You may assume that satellite communications and GPS are available.

For water sampling you may assume a sample size of 3-6 oz. You will need to balance the need for designating and visiting specific pond locations with the feasibility and reliability of sample collection and delivery.

DELIVERABLE

A power point presentation that includes the types of sensors chosen, the unmanned system(s) chosen, sensor collection parameters, unmanned system parameters, sensor delivery method, sensor interrogation method and approximate costs to implement your solution. Also, be sure to include any assumptions you made.

SAMPLE 3: WATER FOCUS

FLOOD RISK MANAGEMENT/REDUCTION

CHALLENGE

The Utopia Department is commissioning your team to develop a strategic plan addressing sewer backups and deep surface flooding issues in the Southport neighborhood.

BACKGROUND

The Southport neighborhood is served by combined sewers, and suffers from sewer backups in addition to deep surface flooding during rain events due to its topography. The neighborhood serves an aged, often low income population that live in older homes that are not in great shape and ones that can harbor mold after a flooding event.

CONSIDERATIONS

Your team will be provided with basic background information on the design storms, existing combined sewer and stormwater infrastructure and basic geographic information to aid in developing a solution. Your goal is to develop an innovative and sustainable plan for reducing or minimizing flooding and sewer backups in this neighborhood using any combination of gray and green infrastructure solutions. Your proposed plan should address engineering, economic, social and health aspects with a "triple bottom line" alternative evaluation approach desired.

DELIVERABLE

Prepare and present your solution and plan to the SPARK Competition evaluation team in oral presentations using PowerPoint as your primary delivery tool.