What do we mean by a "Systems Engineering Approach"?

The world is full of complex problems that require a different approach to addressing them. In the world of engineering, we often look at these problems as a complex system of systems, each working in concert with the others. The discipline of systems engineering, as defined by the International Council on Systems Engineering, is "an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem."

A systems engineering approach is not much different than many of the decision making processes that we go through in our daily lives. When executed in a structured and disciplined manner, these same processes can be expanded to help solve some of the most complex problems in the world. In fact, many of you will find that you use these same processes and tools in many of your professions. This write up is simply provided as a means to remove the apprehension that sometimes accompanies the use of the term "systems engineering".

When we ask that students use a "systems engineering approach" to tackle the case competition problem statements, we are simply asking them to employ a logical approach to identifying potential solutions to a problem while being mindful of the impacts to all aspects of the system in question. Our case competition problem statements encompass broad subject areas and ask that students identify the major players and their needs, decompose the problem, identify the interactions between the various disciplines involved, and use a structured approach to weigh the pros and cons of potential technical solutions to select those options that provide the best chance for success. In these competitions, while technical realism is important, solutions will vary widely given the different levels of importance that each team places on different aspect of the problem. Therefore, just as important as the solution is the process by which the solution was determined.

In reviewing the submissions for "systems engineering approach" keep in mind the following basic systems engineering tools and processes that we expect to see.

1. **Identify the stakeholders**: The people acting in the system and who have a stake in how well the system performs are the keys to identifying the real need of a system. Stakeholders can include patients, hospital administrations, regulators, and medical professionals.
2. **Identify what is important to the stakeholders**: Identifying the stakeholder needs, goals, and objectives will allow the teams to develop figures of merit, or measurable parameters that will allow them to score different options against each other.
3. **Functionally decompose the problem**: Teams must understand the disciplines required to tackle the problem and what their part of the problem looks like. Medical, business, and technical/engineering disciplines may all have a different perspective on the same problem but solutions must be developed that integrate and address those varying perspectives.
4. **Identify the interfaces**: Interactions between the different parts and between the system and the stakeholders are an important aspect of understanding the overall impact of a given solution.
5. **Propose solutions**: Look for evidence of brainstorming and the clear identification of potential solutions to meet the needs, goals, and objectives of the stakeholders.
6. **Assess each proposed solutions**: Using measurable figures of merit, teams should be able to assign relative goodness values to each solution based on what is important to their stakeholders.
7. **Establish and implement the best solution(s)**: The selected solution should have a clear implementation plan and clear justification for its selection. Also bear in mind that often times, the process reveals that there is not a single solution but rather several working in conjunction.