GIFTED EDUCATION NEWS-PAGE (*VOLUME 23, NUMBER 6)*
Published by GIFTED EDUCATION PRESS; 10201 YUMA COURT;
MANASSAS, VA 20109; 703-369-5017 **www.giftededpress.com**

An Example of 360 Degree Problem Solving – More than the Science and Math

Harry T. Roman
Distinguished Technology Educator

(Excerpted and modified from….. Roman, Harry T.; **STEM----Science, Technology, Engineering and Mathematics Education for Gifted Students: Designing a Powerful Approach to Real-World Problem Solving for Gifted Students in Middle and High School Grades**; Gifted Education Press, 2011, [ISBN 0-910609-60-8])

The world is complex, filled with competing constraints. It goes beyond just the math and science. Lots of questions will need to be asked and answered. In this document we shall discuss this with a real example, a 360 degree look at the problem, something a team of employees might be asked to carry-out. Throughout my 36-year engineering career, I directed many similar examples of complex projects and teams. No doubt your students will encounter similar challenges in the future for this kind of thinking is not confined to engineering projects.

Multi-dimensional Problem Solving – Integrating the Curriculum

Let's consider an example of multi-dimensional problem solving. Our case for consideration shall be a solar photovoltaic (sunlight to electricity) system to be installed on the roof of a local school, maybe even yours. We shall note some typical, although not all the possible questions that could be asked with these questions arranged in relevant topical categories. This exercise is meant to be illustrative in format and not totally comprehensive….. so you will appreciate how question asking and project management of those concerns are undertaken.

A project manager would usually be placed in charge of this project and his team of multi-disciplinary talents would be involved in major aspects of the project, probably managing the topical categories shown below, and reporting progress to him regularly. His staff might include other engineers, an economist, a lawyer, an environmental and safety expert, and probably someone representing the school or school district. Here are some possible concerns the project manager and his staff will likely encounter. Again this is not comprehensive, but an illustrative example to show the range of questions to be considered.

Technology

Shall we use single crystal, polycrystalline, or thin film solar technology?
Will the panels be flat mounted to the roof, or angled at the latitude?
Whose panels and equipment will we order?
How big will the collection panel array be?
Can the school roof support the load of the panels, and its normal snow load as well?
Can we tie into the school's electrical system and sell back excess power to the local electric utility?
How long will it take to order and receive all the panels, wiring, and interface equipment?
What equipment guarantees can be expected?

Economy

What will the cost of this solar installation be?
How long will it take for the energy collected and sold to pay back the initial cost of the system?
What is the local utility buy-back rate for the energy generated?
How much will the yearly operation and maintenance costs for this be?
How will the presence of this installation affect the school's insurance policy and those costs?
Is it better economically to buy cheap solar panels or expensive ones, considering system lifetime and operational costs?
Is it better if the school/town owns the system or does a partnership with an energy purchasing company?

Environmental

Will this installation be detrimental in any way to native animal life or impact avian roosting habits?

Does this installation adversely impact the architectural aspects of the school and surrounding structures/dwellings?
During a fire, will the burning of solar panels release hazardous materials in the air and impact the neighborhood and firefighters?
Does the size of this project trigger the need for an environmental impact statement?

Safety

What are the safety and structural concerns with a roof mounted system and potential worker injuries to be possibly incurred?
In the event of a roof fire, is this installation and its weight a hazard to fire-fighting crews?
How do we protect this installation from lightning?
How do we prevent people receiving shocks if they touch the metal work of the installation?
How do we make sure this system shuts down in the event of a power loss at the utility end, so it does not feed-back and possibly injure utility line workers?

Regulatory

What forms must be filed for the school to qualify for the solar energy tax credits for this system?
How does the school system account for this in its annual budget?
What local town/city building and other codes apply to this installation?
Must we have code approval authorities on-board from the beginning of the project? Who coordinates this…..the project team or the school administrators?
What codes and standards must be complied with to obtain local utility company buy-back?
What is their application process time and how soon do they need to be on-board?

Educational

How do we work in an educational aspect of this installation for the pupils in the school?
Should there be an interactive interface available for students to see how the solar system is working?
Do we make this interface via a webpage or a link via the school webpage?
Is there money for this educational aspect in the original budget or should we include more funding?
Should there be a teacher's resource book for teaching solar system basics and operation that can be used in science and technology education classrooms here in the school? Who should write this?
Should we have some teachers on this project team as well?

Government

How do we coordinate this work with the town mayor and council?
Is there going to be an educational liaison person assigned from the mayor's office, or the board of education?
Is there a protocol we need to follow before speaking to any newspaper or media folks about the project?
If we are asked to host visitors to the site, who will coordinate that or are we free to do so?

Social

Is this system likely to produce a sun glare problem for the surrounding homes at certain times of the year? If so, are there mitigating techniques we can use that will not compromise system operation and collection?
Are other schools in this school system likely also to be candidates for such an installation?
What is the town's general feeling for paying for this system in taxes?
Is there any possibility we could see negative press in local newspapers?

****

As discussed at the beginning of this document, this is by no means a comprehensive itemization of all the possible questions a project manager would be working on. Most likely there will be many more as well, and new ones as the project progresses…..and the inevitable problems that arise during normal construction and start-up. The team may need to be expanded to include other experts as well, and their opinions and specialties consulted. These impact areas are quite realistic for this solar technology, and draw upon the author's thirty years of experience with designing and installing solar energy systems.

Another point to keep in mind…….teams and projects in the business world can last quite a bit of time. In my experience, the teams and projects I directed generally lasted from 2 to 8 years, involved 5-10 team members, and cost $300,000 to $6,000,000 – depending of course on the type of work involved. Most of my team-based projects were in the $500,000 to $1,000,000 range.