Odyssey of the Mind — Turning What Adults Might Call Work Into Play

Making Systems Engineering Soup at hOMe

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My daughter Kyle put another 10 pounds on the test stand, bringing her total to 267, when the structure broke. Not bad for an eight-inch-tall, composite truss-style structure consisting only of balsa wood and glue that tipped the scales at 22 grams. She quickly joined her sister and three other buddies performing "Adventure at Granny's," the team's Fine Arts Element. What were they doing, and how does it pertain to the systems engineering process?

Odyssey of the Mind (OM)

As one **OM** official said, "Trying to explain Odyssey of the Mind to someone who's never seen it ... is like trying to explain how to tie your shoes over the telephone."[1]

According to their Web site (**http://www.odyssey.org/**), **O**dyssey of the **M**ind is a worldwide program that promotes creative team-based problem solving for kids from kindergarten through college. The program helps them learn divergent thinking and problem-solving skills while participating in a series of challenging and motivating activities, both inside and outside their regular classroom curriculum.

Participation is broad, with students from all 50 states, the District of Columbia, and more than 36 nations. For those who win at the local level and go on to win at state or national competitions, the reward is the chance to compete at the World Finals. This year's Finals were held in May at the University of Tennessee.

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KYLE SCHMITZ (RIGHT) ADDS ANOTHER 10 POUNDS ON THE TEST STAND, BRINGING HER TOTAL TO 267, WHEN THE STRUCTURE BROKE. KYLE AND HER TEAM WERE PARTICIPATING IN A LOCAL-LEVEL ODYSSEY OF THE MIND COMPETITION. WINNERS GO ON TO COMPETE AT STATE, NATIONAL, AND WORLD FINALS.

In winter 1998, I was privileged to take on the job of coaching two fourth graders and five fifth graders (of those seven, two were boys) in preparation for the March 1999 competition. My team had been meeting since November 1998.

There were five Long-Term Problems **OM**'ers could solve this year, and ours was the Rati**OM**etric Structure. The requirements for this problem included creation of an "efficient" structure, defined as weight held in pounds divided by structure weight in grams, and problem presentation with style (also called the Fine Arts Element, or FAE). The team also had to be ready to tackle a Spontaneous Problem, which is an unannounced time-critical verbal (name things that are red) or hands-on (build a bridge out of spaghetti, gumdrops, and sticky labels) problem.

Only five team members can participate in either the Long-Term Problem presentation or the Spontaneous Problem. All work in designing, developing, and presenting the solutions must be done by the children. Coaches (and the kids' parents) cannot give design ideas, help

Photo courtesy Holly Schmitz

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KYLE SCHMITZ SHOWS OFF HER TEAM'S TEST STAND, AN 8" COMPOSITE TRUSS-STYLE STRUCTURE OF BALSA WOOD AND GLUE THAT TIPPED THE SCALES AT 22 GRAMS.. THE TEAM FINISHED SECOND OVERALL OUT OF 14 TEAMS IN THEIR PROBLEM AND AGE GROUP. NOT BAD FOR A BUNCH OF OM NOVICES! ACCORDING TO HER DAD, AIR FORCE LT. COL. DAVE SCHMITZ, "THESE CHILDREN ARE ALL WINNERS."

KYLE (LEFT) EXPLAINS CONSTRUCTION TECHNIQUES TO HER TEAMMATE (AND SISTER), HALEY.

build anything, write a line of script, or even place a single drop of glue. The coaches' role then, is fairly well constrained to: providing a place for the team to meet, asking lots of questions, and giving them tools to help improve their processes. One of the tools I taught my team was the Systems Engineering Process (SEP).

The Systems Engineering Process

According to the Defense Systems Management College (DSMC) *Systems Engineering Management Guide,* systems engineering is both a technical and management process designed to effectively transform an operational need into a total system through an optimum balance of all system elements. The SEP "soup" is an iterative process that includes requirements analysis, functional analysis/allocation, and synthesis.

Simplifying somewhat, requirements analysis defines what and how well the system must perform its mission within given constraints. Functional analysis/allocation decomposes top-level functionality (requirements) to lower levels to understand what subtasks must be performed to satisfy system requirements. Synthesis defines the resource (hardware, software, facilities, people, and data) architecture to satisfy the subtasks.

These three iterative steps are guided by the last piece of the SEP, systems analysis and control, which is a set of "tools" used to assure balance is achieved during development. A final aspect of the SEP is verification, to ensure that the final solution does indeed meet requirements.

Systems Engineering Soup at hOMe

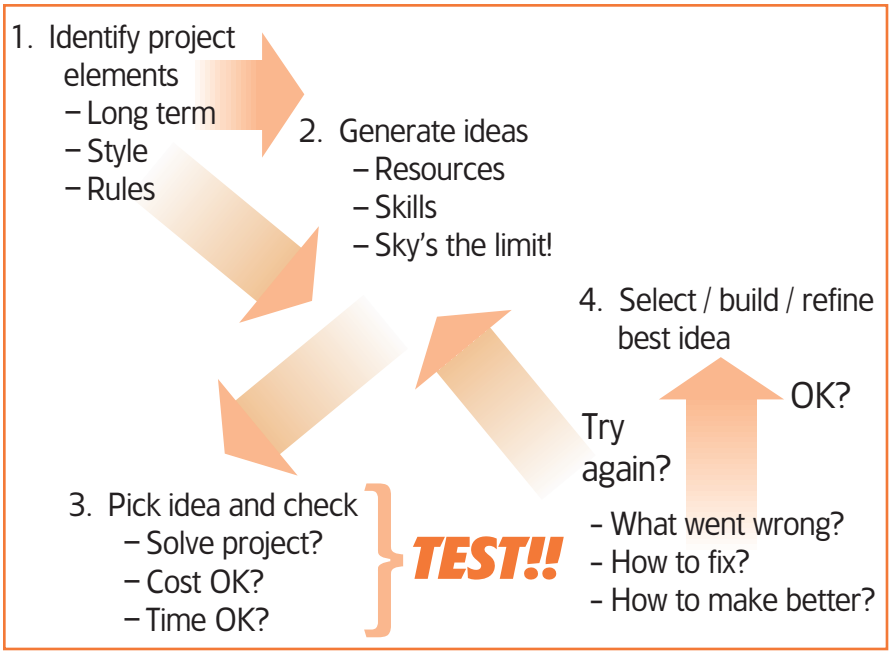
Figure 1 shows what the team and I developed for our design process – our SEP.

STEP 1

Step 1 is clearly requirements analysis, based on the problem requirements as detailed in the **OM**-provided problem statement.

Our analysis is detailed in Figure 2, which shows that the **OM** folks are fully acquisition reform-compliant by stating requirements in performance terms with

FIGURE 1. **OM Systems Engineering Process**



as few technical constraints to creativity as possible, all within a Cost As an Independent Variable environment.

Step 2

Step 2 in Figure 1 is our functional analysis/allocation. What I hoped to do in this step was to have the kids brainstorm structure and FAE ideas, prodded by potential resources available to them. For the structure, the team researched bridge construction, scaffolding, animal skeletons, furniture, woodworking, bonding agents, etc. For the FAE, potential solutions included music, mime, acting, sculpture, painting, dance, etc.

This bounded the problem for them somewhat, but I also highly encouraged (sometimes without effect) no prejudging of ideas based on perceived goodness or technical possibility. Also, we did a skills and interests survey to understand their strengths, and to break the teams into sub-teams.

Steps 3 & 4

Figure 1, Steps 3 and 4, represent our synthesis activity and verification. For example, in structure development the team started out with a basic truss design that weighed 28 grams and held 190 pounds. This was the first data point, with an efficiency of 6.8. By analyzing each structure's failure modes during and after test, the team achieved significant technical parameter improvement over time as shown in Figure 3.

The FAE team followed the same methodology with their "Adventure at Granny's" play, in which they communicated the overall theme of efficiency by focusing on efficient use of the world's resources through recycling. As a side note, there was no requirement for integration of the structure and FAE portions of the Long-Term Problem solution. During the competition, our team did not integrate structure testing into the FAE. At least one team did, which may have had an influence on why we finished where we did in the competition.

Systems analysis and control is clearly (at least for this age group) the responsibility of the coach. My assistant coach and I did analysis and control primarily by asking questions. Is this play humorous or serious? What will the scenery be made of? How many actors are needed? How long should the play be, considering setup time is included in performance time? What type of glue should we use? What does it mean when a structure cross member doesn't break or come unglued during test? What are our competition-day risks, and how do we address them?

A Note on Management

In *Leadership and the New Science,* Margaret Wheatley implies that in order to thrive in a chaotic world characterized by rapidly evolving technologies and competitive pressures, organizations must be equally chaotic. "The potent force that shapes behavior in these

FIGURE 2. **RatiOMetric Problem Requirements Analysis**

Requirements/Restrictions

- Structure must be made out of glue and balsa wood (1/8" x 1/8" strips)
- Laminated wood is allowed
- Efficiency is: $\frac{\text{weight held in pounds (up to 500 lbs.)}}{\text{structure weight in grams}}$
- Weight must be held for 3 seconds
- Structure must be no less than 8" tall, no more than 8–½"
- Structure must have 2" opening running entire length
- Balsa strips can be soaked or steamed in water only
- Weight placement portion ends when structure breaks or at 8–minute time limit
- Adult assistant helps with weights over 20 lbs.
- Decide order of weights in advance
- Any team member or adult assistant needs safety goggles in safety zone
- Membership sign (name and number) legible from 25 feet
- Two additional scoring elements:
  — Fine Arts Element (FEA) performance (cost of items used in the performance must be less than $100)
  — Balsa wood creation

[chaotic] organizations, as in all natural systems, is the combination of simply expressed expectations of acceptable behavior and the freedom available to individuals to assert themselves in nondeterministic ways."[2] These "simply expressed expectations" are often referred to in modern literature as vision.

OM'ers might define chaos as a group of kids with super glue, razor blades, and paint, constantly creating and evolving ideas, turning what adults might call work into play. A la Wheatley, early establishment and constant reinforcement of a vision helped the team harness their energy and stay focused on a program defined by a stingy budget and an initial operational capability that would not slip. Our vision was:

- **Know the customer.** The **OM** folks bury requirements to keep teams attentive! Cost forms, membership forms, membership signs, FAE descriptions, and other requirements are all needed to compete above showing up with a solution. Like any successful organization, the team spent a lot of time understanding customer requirements.

- **There are no bad ideas. OM** values and rewards creativity, even if the solution does not solve the problem or the performance goes awry because a high-risk aspect fails. My mantra was, always, "Decide what you want to do, and then worry about how to do it."

- **Talk a lot.** Since the team formed subteams early, we made a point to close each meeting with a short description of what happened in each sub-team that day.

- **Play as we practice.** Every meeting we practiced solving Spontaneous Problems using terminology the judges use during the competition. The team used the **OM**-approved structure testing apparatus for developmental tests. They used all of their props and scenery when practicing the play, except where a damaged piece meant excessive rework.

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FIGURE 3. **Design Version Technical Performance**

Design Version	Design Characteristics (all trusses, same glue type)	Efficiency
1	2x2 laminated posts, double cross members near top and bottom	6.8
2	1x2 laminated posts, double cross members near top and bottom	7.4
3	1x2 laminated posts, single cross members in middle/corners	8.5
4	1x3 laminated posts, single cross members in middle, single at corners	10.8
5	1x3 laminated posts, double cross members in middle, single at corners	13.2
6 (Final)	1x3 laminated posts, double cross members in middle, single at corners, selected wood	12.1

Today's Children Best Our Country Has Ever Seen

The team was very calm on competition day, in marked contrast to their parents (their coach was a complete basket case). The team had Spontaneous first, and although the rules prevent discussion of the problem, they were obviously happy with the job they did.

The Long-Term Problem presentation went very well also, and the judges gave it glowing remarks. The structure had an efficiency of 12.13, which was very close to the most efficient design the team had ever built. The team finished second overall out of 14 teams in their problem and age group. Not bad for a bunch of **OM** novices!

Today's children are the best our country has ever seen. I was very proud of our Ra**tiOM**etric Structure team and the faith of their parents in this learning adventure. The version of the SEP we used effectively translated user requirements into a design solution. The vision we created kept the team focused without limiting creativity. The children learned about the power of teaming, learned and practiced several quality tools, and practiced being good team members. And finally, the team really impressed the judges when it counted.

Bring acquisition reform and the SEP home to your children. Sign up for **O**dyssey of the **M**ind at your local school, and coach a winning team next year. Why? Because, all things considered, when given the opportunity, *these children are all winners!*

References

1. Schwartz, David M., "Everyone's a winner when it comes to sports for the brain."
2. Wheatley, Margaret J., *Leadership and the New Science*. Berrett-Koehler Publishers Inc., San Francisco, 1992, p. 132.