

Midwest Gateway Newsletter

INTERNATIONAL COUNCIL ON SYSTEMS ENGINEERING

Volume 6 – Issue 1

March 1997

In This Issue

CHAPTER BUSINESS

- 1997 Programs
- Report on Membership
- Chapter Leaders Perform a Variety of Duties

PRESIDENT'S MESSAGE

INTERNATIONAL NEWSWATCH

FEATURE ARTICLES

- Penetrating the Technical Fog: Seven Questions to Help You Find Out What Is Really Going On
- The Need for Systems Engineering Comes in Many Forms

POINT-COUNTERPOINT

- How the "Little Things" Count
- How the "Little Things" Count – A Rebuttal

TONGUE IN CHEEK

traditional dinner meeting, the second setting is a tour, and the third is a workshop.

Some of the topics we are looking at are:

- a) Dinner Meeting – Topic: Defense Mapping Agency
- b) Dinner Meeting – Topic: Project Management – Hellmuth Obata & Kassabaum
- c) Tour – Topic: Auto Plant (Fenton, Hazelwood or Wentzville)
- d) Workshops – TBD

Social Programs: Besides the social and networking activities that occur at all chapter functions, we are looking into scheduling a purely social event. The focus at this point is a Cardinals baseball game. The chapter has approved \$300.00 to go toward this event. The money would be applied toward a portion of the purchase price of each member's ticket. Guest tickets will be available as well. Look for further news on this subject in the next newsletter.

Community Outreach: The chapter is looking for a governmental or not-for profit organization that could benefit from some "Systems Engineering". We would like to have a group of members volunteer to participate in this outreach program. It would be a great opportunity to apply your knowledge outside of your traditional career field. We need your help in finding a organization that could use the help.

Your Involvement is Needed!!!: We need a different chapter member to volunteer and take the lead for each event. This is a great way to get involved on a limited basis and allows that volunteer to influence the chapter in a direction that they feel is beneficial. **Please contact John P. Adrian @ 314-233-2755 or by E-mail at: jadrian@mdc.com** with your ideas. Let him know if you are interested in being a lead person for one of the programs discussed above or for one of your own that you have in mind.

Editor: Bob Scheurer

314/234-1608
rscheurer@mdc.com

Chapter Business



1997 Programs

*by John Adrian, Programs Chair
jadrian@mdc.com*

The strength and success of our chapter is a direct reflection of the quality of our programs. This year we are attempting to have a mix of educational, social, and community outreach programs.

Educational Programs: We will attempt to hold three types of educational events in 1997. The first type is the

Report on Membership

by *Ralph Lambert, Treasurer*

rlambert@mdc.com

As of February 1997, the Midwest Gateway Chapter has 85 members. Those members are from eight states in the Midwest – TN, OH, IN, IA, IL, MO, KS and NE. The membership is concentrated in two geographical areas – upstate IL near Chicago (18) and in MO near St. Louis (46). Several years ago, employees from McDonnell Douglas represented a majority of the membership (the Chapter was formed at McDonnell Douglas). They now account for 40% of the membership. Since the start of 1996, 27 new members have joined the Midwest Gateway Chapter.

Chapter Leaders Perform a Variety of Duties

by *Carol Wilke, Director*

cwilke@mdc.com

The Midwest Gateway Chapter of INCOSE consists of the general membership and a Board of Directors. The Board of Directors meets monthly to direct the affairs of the chapter. The Board consists of nine elected officials:

- President
- President–Elect
- Past President
- Secretary
- Treasurer
- 4 Directors

and several standing and ad hoc committees. Chapter elections for officers of the chapter are held in the fall of each year, with the new Board taking office in January of the next year. Members of the standing and ad hoc committees are appointed by the president and approved by the Board. Here's a quick synopsis of each office and committee.

The Board

President / President–Elect / Past President

Election to the office of president is a three year commitment. When elected, the member first serves a year on the Board as President–Elect. Duties for this position include those normally associated with a vice–president position – i.e., stand in for the president when the president is unable to perform the required duties. In addition, the president–elect provides general supervision of all chapter standing committees and working groups. After one year, the president–elect becomes the president of the chapter. At this point the duties include general supervision of chapter affairs,

presiding at chapter and board meetings and representing the chapter to the larger body of INCOSE. In the third year, the then president becomes the past–president. The main duties of the past–president are to supervise the chapter's ad hoc committees, including the Nominations committee, and to serve as the chapter's historian.

On the current Board of Directors, Bob Scheurer serves as president–Elect, John Schrader serves as president, and Ken Kepchar serves as past–president.

Secretary

The office of secretary is a two–year position on the Board. The secretary prepares minutes of all chapter and board meetings, maintains the permanent records of the chapter, prepares the chapter calendar, and prepares the chapter's article for the INCOSE publication INSIGHT. The secretary also receives and distributes the chapter mailings from the International Board.

On the current Board of Directors, Don Hess is serving as secretary through the end of 1998.

Treasurer

The treasurer of the chapter also serves a two year term. The primary duties are, of course, financial in nature, and include preparing the yearly chapter budget, receiving all funds paid to the chapter, maintaining financial records and paying bills, and serving as the point of contact with the International Board on financial matters. The treasurer also serves as the main point of contact with the International Board for membership services and chairs the Membership committee.

The terms for secretary and treasurer are staggered by one year, so that the chapter will elect either the secretary or the treasurer at each annual election. On the current Board of Directors, Ralph Lambert is serving as treasurer through the end of 1997.

Directors

The four directors provide general oversight of chapter affairs and help implement chapter policies and events. Each director is elected for a two year term, with two directors up for election at each annual chapter election. The chapter directors are the direct representatives of the chapter membership, and serve as ambassadors for INCOSE and our local chapter in the local community. The current directors and their term of office are:

- Ken Sivier, serving through 1997
- Carol Wilke, serving through 1997
- Owen Carson, serving through 1998
- Paul Summers, serving through 1998

The Committees

The Midwest Gateway Chapter has four standing committees:

- Ways and Means,
- Communications,
- Programs,
- Membership;

and two ad hoc committees:

- Nominations
- Audit.

In addition, the chapter by-laws allow for the establishment of working and interest groups to work particular systems engineering issues.

Standing Committees

The Ways and Means committee is chaired by the president-elect. This committee has responsibility for maintaining the chapter constitution and by-laws, and considering other rules of chapter business. For example, this committee last year, under the direction of John Schrader, led efforts to revise our constitution and by-laws to better conform with new INCOSE by-laws.

The Communications committee is responsible for publishing the *Midwest Gateway Newsletter* and notices of chapter programs. The committee chair is appointed by the chapter president; Bob Scheurer is currently serving in the post. The committee also manages the chapter's presence on the Internet/World Wide Web and represents the chapter with the INCOSE Communications committee.

The Programs committee plans and coordinates chapter program meetings. This committee, currently chaired by John Adrian as appointed by the chapter president, prepares a master schedule for the year, contacts speakers or instigates preparation of special programs, arranges halls and dinners, and manages the programs budget.

The Membership committee is responsible for recruiting and retaining individual and corporate chapter members. This committee, chaired by the treasurer, serves as the point of contact with the INCOSE Membership committee.

Ad Hoc Committees

The Nominations committee is chaired by the past-president, and is responsible for managing the chapter elections. This committee is created in the latter half of each year to seek qualified candidates for each office, prepare and present the candidates to the chapter membership, conduct the elections and collect and tabulate the results.

The Audit committee is responsible for conducting an annual audit of the chapter's finances. The committee consists of three chapter members that do not serve on the Board of Directors. The committee members are appointed by the president. Audits are generally done in late March to early April to supply data needed by the International Board at their fiscal year-end in April.

Working and Interest Groups

Each of the previous committees are constituted to help the chapter run smoothly. Working and Interest Groups, on the other hand, are the vehicle for technical systems engineering work to be performed by the chapter.

President's Message

by John Schrader, President

mschrader@mdc.com

In this, my first contribution to the President's Message, there are two topics I would like to address. First, I feel I need to introduce myself to you. Secondly, the board of the Midwest Gateway Chapter of INCOSE would like to share with you what we are trying to accomplish this year.

Relative to the first topic, I have been working for McDonnell Douglas for over thirty-seven years. My initial assignments were in Guidance and Control Mechanics but later on my interest and job responsibilities focused on System Engineering. I suggested the need for some training courses in System Engineering and taught a System Engineering class for a number of years. The programs to which I have been assigned have all been either space or missile programs. I became a member of INCOSE shortly after the chapter was formed here in St. Louis. My wife is one of five campus ministers at Southern Illinois University – Edwardsville. We have three children, two boys and a girl, all of whom are married. So far, there is one grandchild with another on the way. So much for my introduction to you.

During the past two years, the number of events sponsored by this chapter have been few in number. Two years ago, many members of this chapter were very much involved in working on the INCOSE (the NCOSE) symposium which was sponsored by your chapter. The experience of chapters sponsoring the symposium is that the year following the symposium seems to be a "down" year. I don't mean to give this as an excuse for not having chapter activities, it just seem to be the "facts of life".

Sponsorship of the national symposium has resulted in building up our treasury and allowing us provide our chapter membership with some good programming without heavy demands on individual members' financial resources. In February, your board approved a budget which our program chair, John Adrian, may utilize during the coming year. As a matter of fact, chapter funding has already been used at two chapter events (November '96 and January '97) to subsidize the cost of meals for chapter members.

Our program chair has tentatively suggested two dinner meetings, one or two tours, a baseball game, and two events related to this year's symposium. The board is considering a one day workshop on some System Engineering topic. As soon as the plans for these events firm up, we will let you know about them. We would like to be able to schedule chapter meetings early. However we are at the mercy of the speaker's schedule.

The members of your board are trying very hard to provide for you – the chapter membership. We do ask that you do something for us and perhaps yourselves at the same time. Attend chapter meetings, they are for you. Give us feedback relative to what we can do better or provide us with ideas for events which would be beneficial to you. Volunteer to assist us in planning and implementing an event. You are paying dues to belong to this organization. That investment will be maximized by participating in chapter activities.

InterNational NewsWatch

INCOSE – A Look at the Past, Present, & Future

*by Kenneth J Kepchar, Past President
m138595@mdc.com*

(Observations of the author based on remarks delivered by Eric Honour, INCOSE President, to close the Region II regional conference in Las Vegas on 27 April 96)

Five plus (5+) years ago NCOSE was a small group of passionate believers (we call them “graybeards” now) organizing a “council” on the topic of Systems Engineering. Since that time, the complexity of the world has risen as markets became global, our government is experiencing its own version of “downsizing”, and a number of commercial sectors are searching for methodologies to more effectively manage their business. Likewise, NCOSE grew from that handful of folks to over 2000 strong. We've shifted from an aerospace concentration attempting to transplant those experiences to a broad base of industries convening to share

experiences and (hopefully) develop a common language.

INCOSE has formed a small group at the international level to formulate a VISION to lead the organization into the 21st. century; to transform it from an all-volunteer organization into one that can take its rightful place in the professional environment; and participate as THE voice of Systems Engineering toward issues that face us in a global market. The nature of the challenges facing NCOSE has changed from the days in Memphis and Seattle. Now, as we transform ourselves into the “I” in INCOSE, the level of complexity has been ratcheted up another notch. The present dimensions that we need to deal with are image, marketing, and political in nature. We need to forge liaisons with other professional societies (IEEE, etc.) who feel that they have a voice in what this thing called “Systems Engineering” really represents. We must find a way to be heard and respected by governmental and other regulatory bodies. And, we need to market ourselves as being the primordial voice on a subject so near and dear to us.

The extensive debate within INCOSE over a common definition for Systems Engineering illustrates a point that should be taken to heart. Within our own ranks we need to develop a recognition that Systems Engineering comes in many forms and flavors. In my opinion, Wayne Widmore made a valuable contribution towards this end by formulating what Systems Engineering ISN'T vs a SINGULAR view of what it is.

Those of us who have deep convictions need to share them. Any exchange among ourselves must be constructive and move us closer to a consistent perspective as an organization, rather than a collection of discordant voices, each trying to supplant the others. A spirited debate over the fundamentals is healthy and invigorating, but it should take into account how we're seen by others. Our internal search for the ideal viewpoint MUST be balanced by a common voice to others. Society has always placed more value on consistency of purpose than on interminable debates over perfection.

Eric's remarks were aimed at INCOSE as a whole. But the heart and soul of this organization are its individual members and their collective wealth of experiences – whether they're in Missouri, California, Canada, or Australia. The fabric that holds this “council” together is its chapters. They provide the nexus for the creative spirit of our members to be channeled and nurtured. Without a strong network of chapters, we would still be a small group debating issues in a council setting. Please make every effort to not only support, but actively participate in, your chapter. It's there for you, but you have to make it happen!

Feature Articles

Penetrating the Technical Fog: Seven Questions to Help You Find Out What Is Really Going On

by Bill Schoening, International President—Elect
wschoening@mdc.com

Editor's Note: Bill Schoening's article below is the text of his presentation made at the January, 1997 Midwest Gateway Chapter general membership meeting.

You might find yourself working on a project for which you have little personal experience in the primary problem domain. Communication with the domain experts (designers, engineers, and even managers – anyone who has a stake in the existing design) can be difficult. Domain experts may be wedded to their latest design, or they might have been too close to the problem for too long. How do you ask questions that help illuminate the serious underlying issues without sounding confrontational?

Without experience in the domain of interest and little knowledge of the lingo you might feel uncomfortable asking questions with substantial technical content; I know I did. Over the past several years I have used seven questions that help domain experts identify and focus on the real issues without my sounding confrontational.

1. Who are the users and how will they use it?

Instead of questioning the design (which might be interpreted as a challenge), ask questions about who the users are and how they might use the product. For whatever reason, domain experts seldom seem threatened by this question. A good list of potential users is easy to assemble with the help of your domain experts. You might want some outside help in making the list sufficiently broad. But ensure that the domain experts have a hand in preparing the list, and gain their ownership in the product.

The second step (never the first) is to prepare a list of ways each user might use the product. Once again, include the domain experts and look for ideas from people outside the core group.

When to use this question. Use this question when the group is arguing over competing design solutions, or is just stuck with little idea about how to proceed. Do not ask this question too quickly; be patient and let the group struggle for a while. You will have a more accepting audience.

2. If you had the chance to do it over ...?

Not “when” you do it over, but “If you had the chance to do it over, what would you do differently?” This seemingly innocuous question has paid dividends many times over since I started using it 7 or 8 years ago. Most of the existing problems come tumbling out, and you will learn more about the real gut–wrenching issues in 15 minutes than you can possibly absorb. Direct questions in a briefing or discussion seem to bring out defensive responses. Don't forego the direct questions; just recognize the limited content of the responses. This particular approach has a number of things going for it.

First, it is an open ended question that invites the other person to broaden the field of inquiry into things you never considered.

Second, the respondents are encouraged to speculate about how they could have done better. When was the last time you talked to an engineer who didn't think a better job could have been done if time and money had not been so constrained. Designers are often frustrated perfectionists, and this question caters to their perfectionism. There is no embarrassment associated with answering this question because it is not confrontational.

Third, the form of the question puts the two of you on the same side. There is a subtle suggestion that “we” are in this together. The reality is that once the real issues are explained, you are on the way to becoming an expert. Maybe not in every facet of the problem, but certainly with regard to some of the unsolved issues.

When to use this question. Use this question following a briefing, but don't bother if it is already answered. Some people have learned that I ask this question, and build the answer into the briefing. Good idea; they are doing some good self–analysis ahead of time, and their products are more robust. Also, this is a question I have learned not to ask of more than a few people in the same meeting. The responses become mechanical and clones of earlier responses.

3. What concerns you the most?

This question has much the same character as “If you had it to do over again, ...” Designers and engineers are major worriers about the tasks yet to be done. I usually phrase it something like, “Now that you have completed the current task, what concerns you the most about the future?”

This question is thought provoking, and many times the concerns are vague and unfocused. When you ask the question, you are providing an outlet for expressing concern, but are causing the respondent to put vague worries into concrete terms. You are forcing them to

think on their feet. Don't press if the response is vague. I often suggest that they think about the question and come back to me later. Once again, I am putting myself on their side.

When to use this question. This question is best used when the discussion has been about what is going to be done next. In contrast, "If you had it to do over" is best used for something that has been done already. The admonition about asking everyone in the group applies to this question. It is often easier to parrot back what the earlier respondent said than to think about your own problems.

4. Hypothetically, what if ...?

I owe this question to Deborah Castleman. The idea is to state hypothetical conditions that nullifies the feasibility of two competing approaches, neither of which is truly satisfactory. Unless advocates of competing solutions find a new solution, the existing approaches are losers.

To find a new solution, the participants have to cooperate, so the key is to state the hypothetical in terms that force cooperation.

When to use this question. Use this question when trying to elicit compromise from competing approaches.

5. What other ways could this be used?

The context for using a product often becomes narrowed during the detailed design phase. Engineers begin to focus on those contexts that present the most challenging problems for the designers. At the same time, good products find uses in their later life that were never envisioned by the creators of the original product. I doubt that the designers of the first word processors had in mind using home computers to create complicated newsletters and large documents with graphics linked from external sources, fancy fonts, complex page layouts.

When to use this question. I use this whenever I sense that unstated and restrictive "requirements" have established a choke hold on the creative process. I stay away from the question if the brainstorming process is running amok long after we have moved on to more focused activities. The question is not intended for starting a "solution in search of a problem."

6. What larger system is this part of?

Sometimes experience is baggage, particularly when engineers have been working the detailed problem for a long time. They begin to assume very narrow ranges of system and scenario contexts. Sometimes one

must remind a radar designer that the radar is but a subsystem of an airplane, that is just a part of an airwing, which in turn is just part of the Navy. Or the design is overly focused on delivering standoff weapons in adverse weather. What about delivering dumb bombs on a clear day against a target with strong point defenses.

When to use this question. Use this question only when the design appears to be too tightly constrained. It differs from Question 5 in that the uses are not being extended; it is the context that needs to be expanded.

7. Show me how you are going to

I picked up this particular approach from Bart Huthwaite. Instead of saying, "Do the following." this question leaves the approach up to the person you ask. They might even have a better solution than anything you would suggest.

The tone of Bart's form of the question sounds imperious. I prefer a less confrontational form such as, "When the bosses review this, I think they might ask us to show them how we are going to" The result is the same, but is received and acted upon by peers (and sometimes supervisors) more gracefully.

When to use this question. Make sure you phrase the question without sounding overbearing. Opportunities for its use seem unlimited

Conclusion

No matter what questions you use, always let the experts tell their story first with no interruptions other than for clarification. Be patient; being heard minimizes the inevitable tension that exists between experts with long histories on a project and the not-so-expert Systems Engineer seeking to understand what is really going on. I think of myself not as a future expert, but as someone helping others discover more about themselves and their system. I am only a facilitator of the process.

The Need for Systems Engineering Comes in Many Forms

*Submitted by Jack Ring, Innovation Management
32712 N. 70th St.
Scottsdale, AZ 85262-7143 USA*

I do not agree that the top is "wherever" the project starts. I think the SE process must start with a delineation of what the operational system is supposed to help accomplish. In this vein, by the way, the operators and administrators of the system are part of the system.

Perhaps INCOSE members argue unnecessarily because we are talking about different things without

realizing it. I use the following taxonomy of system types:

1) There are mission systems (typically found in DoD). These start with an Operational Need and follow the “Lake Life Cycle” which gets them to retirement. Most INCOSE members are experienced in engineering this type of system.

2) But there are Self-test and Automatic Repair types of systems which exhibit a weak form of homeostasis. The human body is homeostatic -- if your brain chemistry is not too fouled up. And we put a lot of effort into STARRING manned space flight systems. The Navy understands this more than most because their systems have to be much more self-sufficient.

3) Then there are self-adaptive systems which “end” in a (continuously) evolving stage, thus never get to retirement (or get to retirement at the instant of first evolution). Either way the “Lake Life Cycle” does not apply. Most commercial product lines have to be this type of system. Interestingly, most people think of a person as an individual but, from the behavior view, each is a system -- with up to 23 modes of operation (popularly called split personalities).

4) Then there are learning systems. These are not only self adaptive but also goal seeking. Their essential properties are: g) a goal, t) a trigger, c) competency, e) energy, s) status and f) feedback, the latter being capable of closing the gap between [goal - status]. This is the class of system that Business Process Reengineering people should be designing. Most of them are designing Type 1 or 2 systems. Health care (actually, sickness care) must be designed as this type of system.

5) Finally, there are Emergent Systems such as the butterfly in China causing a hurricane in Columbus. These are the complex, adaptive systems that the crowd at the Santa Fe Institute get to play with. And, in the real world, most systems must be Complex Adaptive. Very few are Mission (unless you want to leave out the operators while designing the system and expect the Air Training Command to figure out how to “design and produce” the rest of the system).

It follows that the goals, methodologies and techniques for SE’ing a system are much different depending on which type of system you are going to SE. In my view, most of the prescriptions for SE (such as 499) are compatible with Type 1 but are woefully inadequate for Type 3 and beyond. We need a EIA-632 for Type 4 and, hopefully, Type 5.

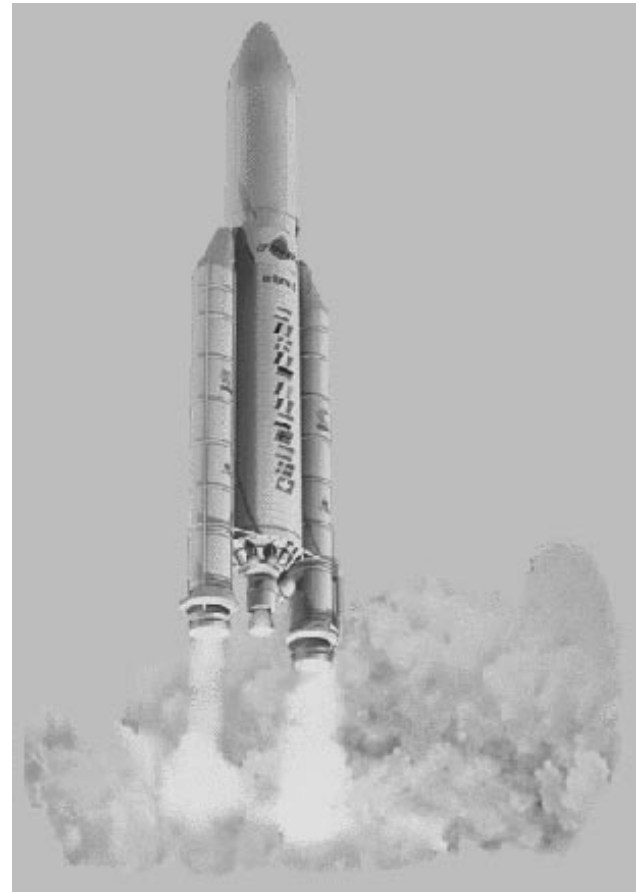
Point – Counterpoint

Editor’s Note: Below is some background material for lead-in to the point-counterpoint discussion. It was obtained from the web site of the European Space Agency (<http://www.esrin.esa.it/htdocs/esa/ariane/>).

The new Ariane-5 launcher will make the Ariane series more competitive by improving performance, reducing launch costs, raising the reliability rating and increasing the diameter of the space available for satellites under the fairing.

An Ariane-5 launch will actually cost less than a launch by Ariane-4, and the new launcher can carry still heavier satellites while providing even greater reliability. Ariane-5 can place two 3000 kg satellites simultaneously or one satellite with a mass of up to 6800 kg in geostationary transfer orbit, compared with a maximum Ariane-4 payload of 4400 kg.

Ariane-5 will also provide Europe with access to low Earth orbit for service missions to space infrastructures like the international space station Alpha. It can transport automatic payloads, station elements and manned vehicles.



Ariane-5 Rocket

How the “Little Things” Count

Submitted by David Ainley
ainleyd@macom.com

It took the European Space Agency 10 years and \$7 billion to produce Ariane-5, a giant rocket capable of hurling a pair of three-ton satellites into orbit with

each launch and intended to give Europe overwhelming supremacy in the commercial space business. All it took to explode that rocket less than a minute into its maiden voyage last June, scattering fiery rubble across the mangrove swamps of French Guiana, was a small computer program trying to stuff a 64-bit number into a 16-bit space.

One bug, one crash. Of all the careless lines of code recorded in the annals of computer science, this one may stand as the most devastatingly efficient. From interviews with rocketry experts and an analysis prepared for the space agency, a clear path from an arithmetic error to total destruction emerges.

To play the tape backward:

At 39 seconds after launch, as the rocket reached an altitude of two and a half miles, a self-destruct mechanism finished off Ariane 5, along with its payload of four expensive and uninsured scientific satellites. Self-destruction was triggered automatically because aerodynamic forces were ripping the boosters from the rocket.

This disintegration had begun instantaneously when the spacecraft swerved off course under the pressure of the three powerful nozzles in its boosters and main engine. The rocket was making an abrupt course correction that was not needed, compensating for a wrong turn that had not taken place.

Steering was controlled by the on-board computer, which mistakenly thought the rocket needed a course change because of numbers coming from the inertial guidance system. That device uses gyroscopes and accelerometers to track motion. The numbers looked like flight data -- bizarre and impossible flight data -- but were actually a diagnostic error message. The guidance system had in fact shut down.

This shutdown occurred 36.7 seconds after launch, when the guidance system's own computer tried to convert one piece of data -- the sideways velocity of the rocket -- from a 64-bit format to a 16-bit format. The number was too big, and an overflow error resulted. When the guidance system shut down, it passed control to an identical, redundant unit, which was there to provide backup in case of just such a failure. But the second unit had failed in the identical manner a few milliseconds before. It was running the same software.

This bug belongs to a species that has existed since the first computer programmers realized they could store numbers as sequences of bits, atoms of data, ones and zeroes: 1001010001101001. . . . A bug like this might crash a spreadsheet or word processor on a bad day.

Ordinarily, though, when a program converts data from one form to another, the conversions are protected by extra lines of code that watch for errors and recover gracefully. Indeed, many of the data conversions in the guidance system's programming included such protection.

But in this case, the programmers had decided that this particular velocity figure would never be large enough to cause trouble. After all, it never had been before. Unluckily, Ariane 5 was a faster rocket than Ariane 4. One extra absurdity: the calculation containing the bug, which shut down the guidance system, which confused the on-board computer, which forced the rocket off course, actually served no purpose once the rocket was in the air. Its only function was to align the system before launch. So it should have been turned off. But engineers chose long ago, in an earlier version of the Ariane, to leave this function running for the first 40 seconds of flight -- a "special feature" meant to make it easy to restart the system in the event of a brief hold in the countdown.

The Europeans hope to launch a new Ariane 5 next spring, this time with a newly designated "software architect" who will oversee a process of more intensive and, they hope, realistic ground simulation. Simulation is the great hope of software debuggers everywhere, though it can never anticipate every feature of real life. "Very tiny details can have terrible consequences," says Jacques Durand, head of the project, in Paris. "That's not surprising, especially in a complex software system such as this is."

The European investigators chose not to single out any particular contractor or department for blame. "A decision was taken," they wrote: "It was not analyzed or fully understood." And "the possible implications of allowing it to continue to function during flight were not realized." They did not attempt to calculate how much time or money was saved by omitting the standard error-protection code.

"The board wishes to point out," they added, with the magnificent blandness of many official accident reports, "that software is an expression of a highly detailed design and does not fail in the same sense as a mechanical system." No. It fails in a different sense.

Software built up over years from millions of lines of code, branching and unfolding and intertwining, comes to behave more like an organism than a machine. "There is no life today without software," says Frank Lanza, an executive vice president of the American rocket maker Lockheed Martin. "The world would probably just collapse." Fortunately, he points out,

really important software has a reliability of 99.9999999 percent. At least until it doesn't.

Tongue in Cheek

A Letter from Homomorpheus, A Scribe of the Order of the Divine System

a.k.a. Fredrick A. Steiner

fsteiner@mmail2.hac.com

To all ye brothers and sisters of the gospel of Systems Engineering, Greetings! May thy labors be blessed with insight, that thou may become a font of structure and system understanding to the heathen among us all.

It has been disclosed, via the miracle of the mail of the electron, that disharmony has erupted among the followers of the gospel of Systems Engineering! Can it be true? And over so small a matter as the vanity of the title of "Systems Engineer"? Peace be with thee, my brothers and sisters! Such disharmony has not been seen since the long fought battle of the trailing "s"! And for what?

Yea, verily, the gospel of Systems Engineering has planted the feet and strengthened the arm of the Manager of Program, and has given substance to the secret workings of the Chief Engineer and Director of Technical. It has served as a guidebeacon for craftsmen of Wares that are Soft, and of Wares that are Hard. It has served as a refuge for the followers of Quality, Safety, and Support, as well as the minions of Test and Integration. Had it not been so, it would have been a false gospel, indeed!

Let us not, my brothers and sisters, debase the gospel by confining it to a single name! Systems Engineering cannot be put in a box! Let us simply embrace the evangelical precepts of the gospel as disclosed to us by Sir Gerome of Lake, Sir Brian of Mar, Bro. Eberhard and Bro. Mack! The heathen care not what the followers of the gospel call themselves, yet they continue to flounder in darkness! My brothers and sisters, cease thy bickering and concern thyself with ministering compassion, structure, and meaningful system models to those who need them most. They, in turn, will find a name for thee, and that will be thy reward!

Let us apply the gospel to our own actions. Let us concentrate on requirement before function, and function before form. Let us establish metrics on our own lives, and judge our alternatives accordingly.

Amen.

How the "Little Things" Count – A Rebuttal

Submitted by Paul Davies, Chief Systems Engineer

Racal Radar Defence Systems Ltd

paul.davies@rrds.co.uk

I have read the original of the failure report and I don't think your summary is entirely fair. I must point out that I have no axe to grind as my company was not involved in any way.

If anything, it turned out to be a bad Systems Engineering judgement call rather than poor Systems or Software Engineering. A major point missing from your analysis was that the team had calculated that they *couldn't* perform all the standard error-bound-trapping routines on all of the variable conversions and still run in real time on the target processor. All 28 conversions were put up for review, and the lateral acceleration one (the one that failed; it wasn't just "faster" as you reported) was exempted on the grounds that it had been exhaustively tested on Ariane 4. Think about it: this wasn't a failure mode that hadn't been considered; it was a failure mode that (under protest, as it happened) was exempted from repeated exhaustive testing. In fact, a repeated model simulation might have picked it up quite quickly. To be honest, I was quite impressed that their SE process had picked up this as a critical design review risk and made a reasonable engineering decision on it! Possibly, the mistake was not to trap for the diagnostic data that was propagated to the parent process after the failure.

As in all projects, they were working to time and cost budgets. You have to draw the line somewhere, and theirs looked pretty reasonable. It is not fair to allude to this failure as a single costly error; to be consistent, if they had tested for this one they would also have had to test for tens of millions more. If they had, maybe the programme would have been cancelled. As it is, they've got a chance to build another one, and the whole industry has learned a priceless lesson.

If you would like to contribute to the Newsletter with a

- *Personal Commentary*
- *Feature Article*
- *Book Review*
- *Cartoon*

*or any other article, contact the editor listed on the front.
Your comments and suggestions on any topic are most
welcome!*

If Undeliverable, Please Return To:

*Ralph Lambert
McDonnell Douglas Aerospace
Mail Code 034-1265
P.O. Box 516
St. Louis, MO 63166-0516*