The reality of a system development climate in a data center

Carl Wales
Alaska SAR Facility
Geophysical Institute, University of Alaska
903 Koyuhuk Dr
Fairbanks AK 99775
phone: voice +1- 907- 474- 7848 fax +1- 907-474-5567
e-mail: cwales@ images. alaska. edu
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- **This may seem like a random collection of ideas, concepts, and thoughts; but I hope you will, when I have finished, conclude they are relevant to each other and to your interest.**

Disclaimer:

This presentation is based entirely on the opinions of the author and should not bring discredit (or maybe even credit?) to any federal or state government organization.

Mistakes are mine-- credit and thanks go to Barb Severin for the elimination of many mistakes & typos.

Acknowledgement:

I have stolen some ideas of

Phil’s and Norm’s *

and included those ideas here.

* Two very talented engineers I work with.

Why do you care?

The content of this presentation may help you as providers, designers, or developers of products who may find it useful to hear what are some -- in one person's opinion -- of the struggles that go on "in the field" and/or "on the other side of the fence."

Note: I speak from a technical/engineering *management* experience and point of view

Wales Engineering

Many times a customer may have a problem and not even know it. In my opinion, the engineer's fundamental responsibility is to first help the customer define the problem(s) and the requirements (as well as fulfill them).

Contents

- Definitions & COTS
  – Case Study
- Design & Development Process
- Glue
- FBC (Faster, Better, Cheaper)
  – Case Study
- Purple Peanut
  – A real world problem of today
- People & Software

There is a common thread to all this!

Data Definitions*

- Raw signal data:
  - Data in serial form as it comes down from the spacecraft. It is located in storage by start and stop addresses on the tape.
- Level 0 data:
  - Signal data which has been preprocessed and stored as file based data.
- Level 1 data:
  - Data which represents an image (in either hardcopy or electronic form).

  - * the Wales, not-so-technical version

Definitions

- **COTS** (Commercial Off The Shelf)
  - **a) Vendor sells hundreds (or thousands or millions)**
  - **b) Vendor sells a few, does not keep any in inventory**
    - **Possibly no spares available even for warranty**
  - **c) Vendor has a catalog item but sold only one or two**

Definitions (cont.)

- COTS (cont.)
  - d) Vendor takes a catalog item and makes custom modifications and sells it as COTS
  - e) Vendor has an idea he wants to develop into a product once someone agrees to buy it

Buy COTS

- Pros:
  - Customer gets a lot of non-recurring engineering (NRE) at much lower cost
  - Sustaining costs are spread over a large number of customers
  - Reliability is often very high
- Cons:
  - Product does not exactly meet the needs of customer/user

Buy Modified COTS

- Buy COTS and have the COTS modified
  - Example: issue an RFP with requirements, let vendors propose modified COTS product as a solution
- Pros:
  - Customer gets a lot of already completed NRE at no additional cost, gets more of the product capability needed.
- Cons:
  - Product loses its “virginity” as COTS and most of the long term benefits.

Buy/Build Custom

- Pros:
  – Customer gets exactly what is needed
- Cons:
  – Customer pays high cost, pays all NRE, and pays full sustaining costs.
    - Translated: higher life cycle costs and most probably lower reliability

Case Study: Build in-house

- Contractor designs & builds (project needs 5) Transit Navigation receivers rather than buy (or even modify a production product).
  - Pros: Kept company personnel working on design and construction of that subsystem.
  - Cons: Project could not afford the NRE that Magnavox put into the production product (thousands sold for ~$2000). The custom version failed a few days into the year life expectancy of the buoys they were installed in.

Design & Development Process

- Customer Requirements
- System Requirements
- System Design
- System Development
- Acknowledge mistakes (warranty work, etc.)
- Somewhere a buy/build decision(s) is made

System Requirements

- System Requirements
  - Performance
  - Cost (maybe including life-cycle costs)
  - Physical
  - Environmental
  - Schedule

Possible Design Approaches

- Buy COTS and modify your requirements & needs to fit the capabilities of the product
  - Example: a spreadsheet program
- Buy COTS and have Vendor provide custom changes
  - Example: Issue an RFP and have a vendor make modifications to their COTS product to meet your custom needs

Possible Design Approaches

- Buy COTS pieces and “glue” them together.
- Build Custom

The COTS Choice:

- Non-Recurring engineering costs can be spread over a large number of units (the larger the better)
- Quality is probably higher because of NRE, economies of scale, and the numbers sold
- Sustaining Engineering is spread over a large number of units

COTS & Glue

- So everyone wants the benefits of COTS. But what happens if you buy COTS and then still insist on use in a non-COTS way--the customer has to provide the glue to hold the COTS building blocks together. The glue can become very sticky and messy (another way to describe expensive).

COTS & Glue (Cont.)

- The most common use of COTS in major systems will be like the peanuts in a piece of peanut brittle.
  - In making peanut brittle, the easy part is providing the peanuts.

Faster, Better, Cheaper

- Hot Political Issue: A buzzword for the decade.
- If one does not wholeheartedly embrace the idea than one is considered as being against progress, change, and process improvement.
- Faster, Better, Cheaper is not a road to success by itself.

Faster, Better, Cheaper
(Cont....)

- Works better for large volume products

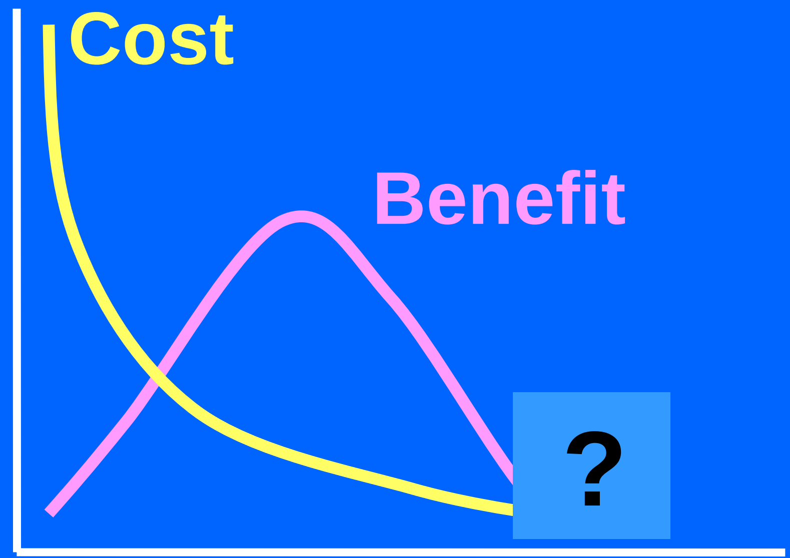
  Example: see the following case study on sonobuoys

- Risk can easily go up from reduced testing and/or reduced reliability (which reduces costs).
  - Example: A $1B spacecraft costs more than a $60M one. Maybe you can get more for your money if you spend $1B and buy many $60M spacecraft but you can't pay $60M and get the equivalent of a $1B spacecraft. The Lewis spacecraft was a ~$60M spacecraft--see the following case study.

Faster, Better, Cheaper

Some myth and some reality

- Reduced costs are always nice--but at some point lower costs come at a price: higher risk, lower reliability, etc.



Wales theory

Case Studies

- Lewis spacecraft
- Sonobuoys

Was it faster, better, cheaper ???

The failure board also assessed the role of the "faster, better, cheaper" project management approach in the Lewis program.

"The Lewis mission was a bold attempt by NASA to jumpstart the application of the ’faster, better, and cheaper’ philosophy of doing its business," said Christine Anderson, chair of the failure board, "I do not think that this concept is flawed. What was flawed in the Lewis program, beyond some engineering assumptions, was the lack of clear understanding between NASA and TRW about how to apply this philosophy effectively. This includes developing an appropriate balance between the three elements of this philosophy, the need for well-defined, well-understood and consistent roles for government and industry partners, and regular communication between all parts of the team."

Lewis Spacecraft

- Failed in the first few days in orbit.
- Primary failure was in attitude control.
- Lack of 24 hour staffing of operations center probably contributed to the loss.

Case Study--Sonobuoys

- From 196x to 1982:
  - Cost went down in $/buoy in spite of inflation
  - production time reduced
  - still used discrete semiconductors
  - over 95% reliable (designed to 98%)
- *VERY* fierce competition

Faster, Better, Cheaper
(Cont.....)

- Faster: If the same job can be done quicker (less labor hours, and often in less calendar time) it is often--*but not always*--cheaper. (Were corners cut?)
- Better: If competition is fierce products will be made better. But it is easy to sacrifice quality for the sake of lower cost.

Faster, Better, Cheaper
(Cont.....)

- Cheaper: Only if economies can be achieved by intelligent and proper application of faster and better.

A Real Life Case Study of the pressures for use of COTS and the pressures of Faster, Better, Cheaper

The "**Purple Peanut**"

The Story of the Purple Peanut Part 1

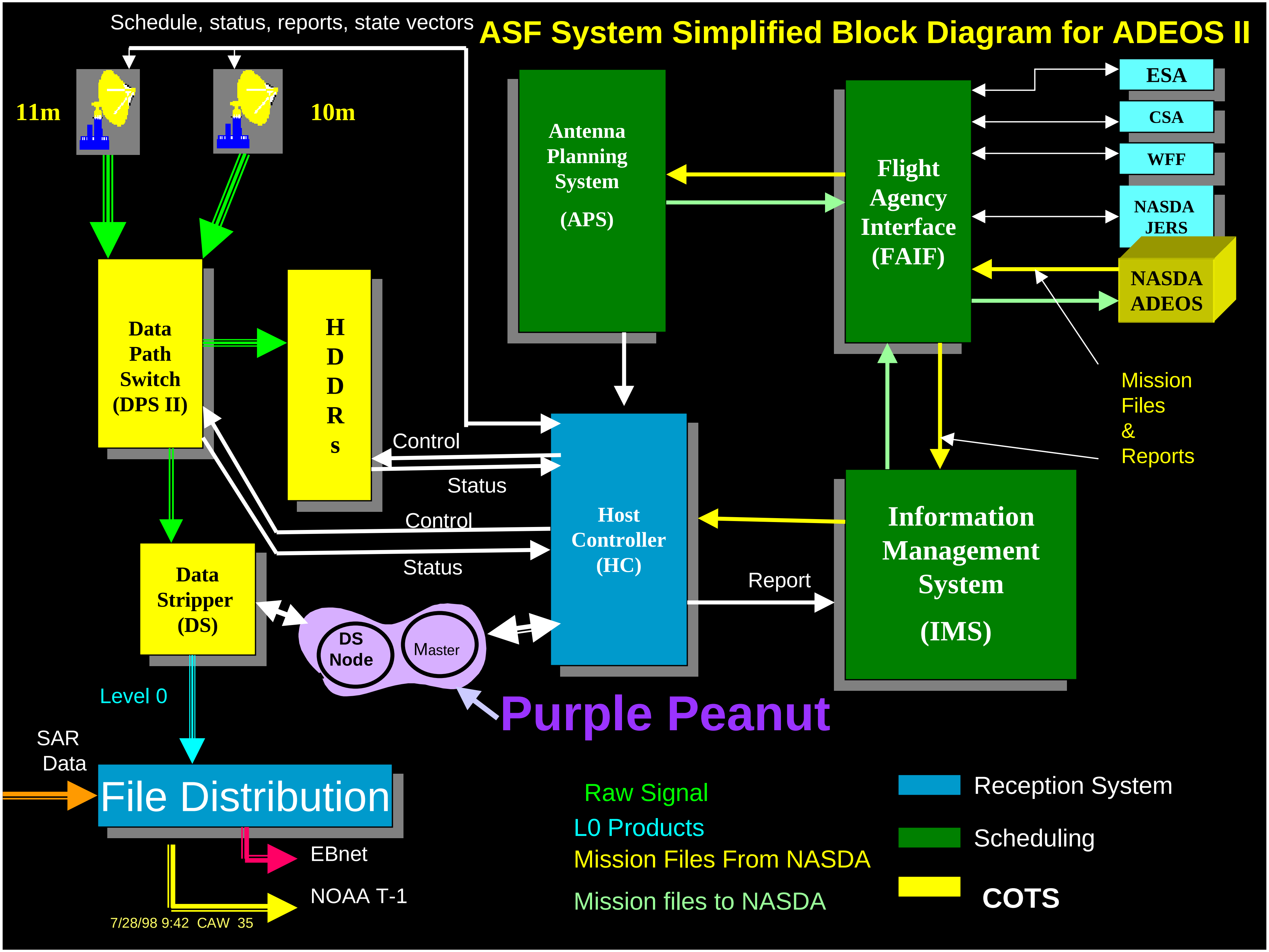
- Fundamental philosophy of the sponsor is Faster, Better, Cheaper
- Funding and sponsor dictates use of some COTS
- International partner specifies customs requirements

The Story of the Purple Peanut Part 2

- Use COTS data stripper/Level 0 Processor
- Subsetting of one of the types of level 0 products*
    - * In this case select a small geographic area out of the large area in the data
- Control the Data Stripper and the subsetting

The Story of the Purple Peanut Part 2 (Cont.)

- Compile reports--slightly *different*--required by different agencies


ASF System Simplified Block Diagram for ADEOS II
Schedule, status, reports, state vectors
11m
10m
Antenna Planning System (APS)
Flight Agency Interface (FAIF)
ESA
CSA
WFF
NASDA JERS
NASDA ADEOS
Data Path Switch (DPS II)
H D D R s
Control
Status
Control
Status
Host Controller (HC)
Report
Information Management System (IMS)
Mission Files & Reports
Data Stripper (DS)
DS Node
Master
Purple Peanut
Level 0
SAR Data
File Distribution
EBnet
NOAA T-1
Raw Signal
L0 Products
Mission Files From NASDA
Mission files to NASDA
Reception System
Scheduling
COTS
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Reports: one person's bit bucket is another's data mine

- Using one level 0 processor and one reception and data system provide reports of various kinds to various agencies. The reports may have a 95% overlap in content. But the last 1% of each report is expensive.

Do you want COTS?

- Will it fulfill your requirements?
- Do you want to be the first customer?
  - Maybe influence the specifications more than later customers.
  - But?

Do you want serial number 1?

- This is a judgement call. If the product is from a major vendor with a reputation they want to preserve then having a low serial number for a high visibility product will help get quality technical support.
- But if the vendor is an unknown, then ???

Case Study

- ASF has an HDDR with a variable rate buffer that were some of the first sold in the US
- ASF has a serial # 5 “COTS” processor
  - No spares at vendor
  - Definitions of terms were different so an interrupted signal was a problem.

People

- People are part of the process
- They cannot be forgotten

Personalities at work

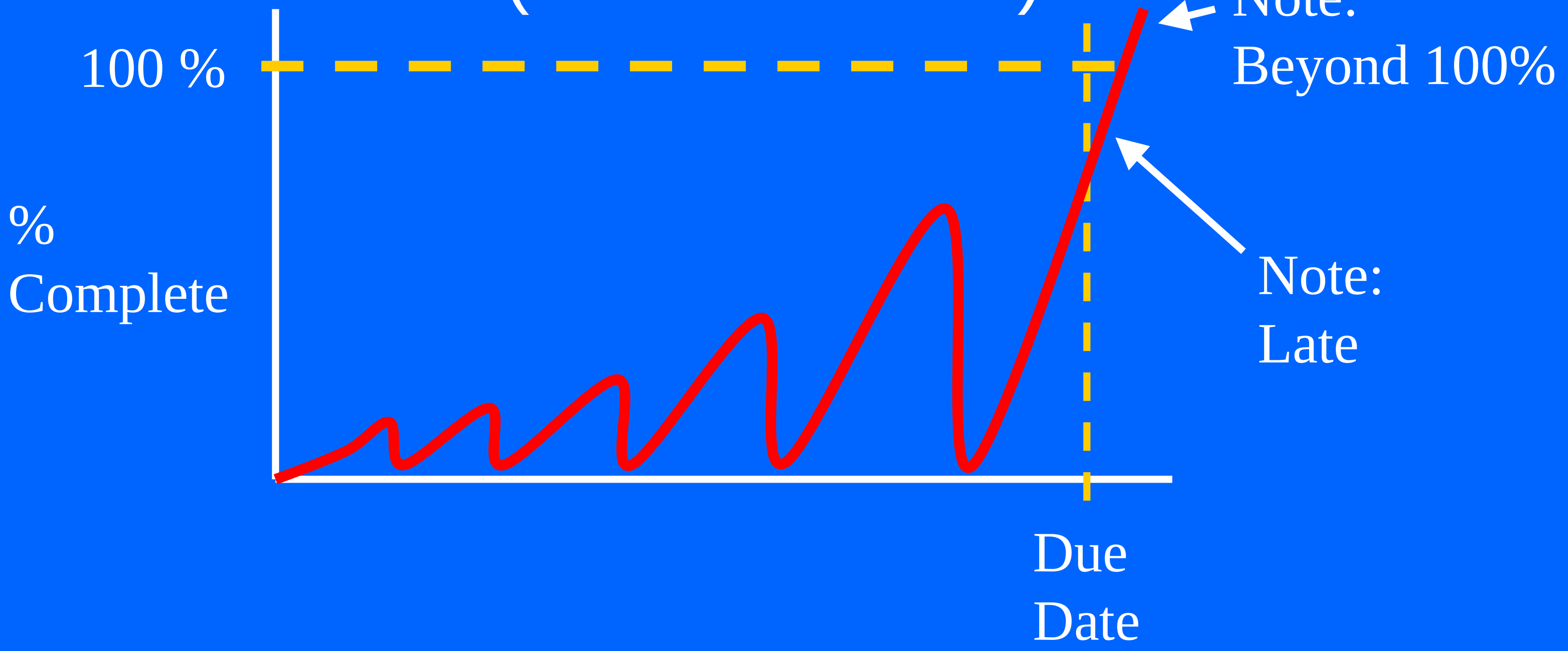
- “I can design a better one than they did!”
  - Maybe you can and maybe you can’t.
  - Sometimes yes and sometimes no.
  - Maybe you can if you put the same labor into the design but maybe your schedule won’t allow that.

Personalities at work (Cont.)

- "I can write better software than they can!"
  - Or
- "Yes, I finished it; but I can make it *better*!"
  - Sometimes better is the enemy of good enough.

Wales Theorem of Software development

(left unchecked)



Why do you care?

- In developing and/or marketing a product it may help to know about some of the problems the end user might be facing.

What can you do? (1)

- Offer more COTS options
- Help users/customers find ways to use your COTS product unchanged.
  - Ask what they need and see if the product offers something similar (say in report or status information). Help them adapt their needs to your product.

Are you?

- Designing a product -- a solution -- which is searching for a problem to solve?

What can you do? (2)

- Ask what the customer really needs and then offer them--***if you have a product***--what they need to meet *their (not your)* requirements.

Conclusions (?)

- Sometimes a user must either accept some limitations or forgo the use of COTS and pay the higher cost of custom.
- A developer works under intense political pressure to use COTS and meet all requirements (cost, schedule, performance).

Conclusions Part II

- FBC can work and be a success but only if used in the proper circumstances and properly applied.