Apr 27th, 8:00 AM


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TECHNICAL PAPER
SESSION 1A
“COST ESCALATION ALERT FOR REQUIREMENTS,
FACILITIES & GSE FOR MOON & MARS PROGRAM”
JOE BROWN
“Cost Escalation Alert for Requirements, Facilities, & GSE for Moon & Mars Program”

By Joseph A. Brown,
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Abstract
A background, timeline for Labor & Material up 10% to 110% Report. How much do you think KSC Construction Cost Escalations was for 2004 to 2006? And more importantly how much will it be for the Space Port Construction for 2007 thru 2015 for our $5 to $10 billion Moon Mars Facility Construction Program. This presentation will give some history as an aid to estimating the escalation for the Future Space Program Construction & GSE. It will also show a Cost Index Comparison to Engineering New Record (ENR) Construction Cost Index (CCI), and Building Cost Index (BCI) KSC Cost Index TR 1511 1974 to 2007, Nine other Cost Indexes, and Consumer Price Index, with Graphic Charts or History Comparison, and a JAB Computerized Cost Escalation Program for 1974 to 2020. Showing Current Projections and Worse Case Scenarios with potential impacts for more Hurricanes, Political, and Economical Impacts such as Oil, Gas, Environmental, Health & Property Insurance, and Building Codes. A Detailed Cost Engineering Cost Escalation Projection and Analysis for the ARES I, V, Orion Crew Capsule ($300 billion - Florida Today). With current examples of Cost Increases for Steel, Concrete, Copper, A Remember When Chart, and other reports of 8%, 10%, and 12% Escalation Projections.

Key Words
$5 to $10 billion, 10% to 110%, 2015, Building Cost Index, Concrete, Concrete Block, Construction Cost Index, Consumer Price Index, Copper, Cost Analysis, Economical, Future Space, Futuristic Cost Escalation, Graphic Charts, GSE, History, Hurricanes, Impacts, Impacts such as Oil, JAB Computerized Escalation, KSC Cost Index TR 1511, Labor & Material, New Record (ENR), Political, Quotes, Remember When, Space Port Construction, Stainless Steel, Structural Steel, Worse Case Scenarios.

Facilities & Ground Support Equipment, GSE
Some KSC facilities are LS-39 Launch Area including: VAB, LCC, OPF’s, two launch pads, support buildings, crawler transporters, three launch platforms “MLP’s”, crawl-away, park sites, SSPF, O&C, RPSF, VPF, LETF, GSE (items used to transport, access, handle, protect, service, and check-out flight hardware/software on the ground such as; RSS, platforms, panels, ECS Systems, cranes, hoists, 15 devices, and auto couplers. See JAB Website www.lobiddervideo.com , Estimating Tools for pictures of GSE and facilities, also see JAB Vols. 14 and 15, pgs. 18-26, and 96-99. Also see website Searchable Vol. 18.
Background

The Author has been an important team leader in the war against construction cost escalation through education, lecturing, training, writing technical papers, improving labor productivity through measurement and surveys, and improving labor productivity by creating and developing over 300 education/estimating cost engineering tools/spin-offs for faster, better, and cheaper engineering (see 9/8/70 letter), chart on survey and votes 1970-2005 for reducing cost escalations. But most importantly, the draft chart date, 1/21/98, shows escalation reduced from 13.8% to a steady 1.6 to 3.76 rate - a great improvement, and one of the major reasons for the economic boom and prosperity, and labor productivity improvement since 1985. This is a major accomplishment of the teams of engineers, constructors, aerospace, and American people. Note the letter, charts, and surveys are part of Joe A. Brown’s cost engineering seminar books; volumes 2, 3, and 7, which are copyrighted by Construction Co$t Co$nultant, Inc.

Also an important team member of KSC design engineering as KSC Lead Cost Engineer which was responsible for saving billions of dollars in the Apollo, Shuttle, and Space Station construction, as well as providing facilities on or ahead of schedule, within budgets. Note many of the over 50 technical papers documenting these facts.

April 1, 2004 - The author issued another Cost Alert due to KSC construction & GSE cost increases and projected increases. The major problems are increase in labor but most important in materials such as; steel, concrete, oil, copper, aluminum, roofing, piping etc. Also increases in insurance, medical, homeowner, etc. which cause increase in labor cost. Major reasons for these cost increases are the China booming economy, the declining dollar value, low interest rates causing a building boom especially in Florida and more recently 4 major hurricanes hitting coastal Florida. It is most important that corrective action to be taken ASAP. Therefore, this presentation is being updated for the 2004-5 cost alert and new surveys.

Timeline

NEW 2004 CONSTRUCTION COST ALERT, LABOR & MATERIALS UP 10% TO 110% TIME-LINE

Dec. 15, 2003 - Concrete going up for ‘04 pg 65
Jan. 23, 2004 - “Wow” 8 craft labor rates go up
Feb. 2, 2004 USA CofF labor up 7% See J.A.B. for details
March 31, ’04 - KSC Cost Index Notes Big Jump In Material Prices and Labor
April 1, 2004 - JAB Cost Alert Steel, Copper, Concrete, Aluminum, Steel, Lumber & Labor, etc., please consider 4-10% per year for escalation, and do a cost analysis on major multi-year projects
April 5, 2004 - ENR Engineering News Record
Notes: Indexes and prices up 5 to 38%. NASDAQ starts to fall
April 14, 2004 - USA gets copy of March 25, 2004 letter to all distribution steel scrap up 60% in one year and 110% in 2 years – Pipe and fittings priced at delivery only. No more holding price 30 days to 6 months. Hard to bid projects. One comment some Government contracts may have to include Escalation clause.
April 15, 2004 - JAB Cost Alert page 31. Consider 4-6% per year escalation and do cost analysis on major multiyear project. (Revised to 10%)
April 16, 2004 - JAB received cost engineering report on steel increase on Church project causes increase from $5.3 million to $5.5 million in 6 weeks.
April 18, 2004 - JAB received Rebar Cost Study showing bid cost increases because scrap steel prices increase.
April 19, 2004 - More trade labor increase electrical – 2nd time this year. Davis Bacon – April 2, 2004 - new labor rates with PT&I from $20.95/hr truck driver to $47.95/hr elevator construction. (Ironworkers $44.52, electricians $41.43, sprinkler fitter $44.40, pipe fitter $41.91 April 2004 - Sprinkler contractors reportedly using Schedule 10 – instead of Specified 40 – may have to be replaced in 2 other new buildings. However may be hurting to use schedule 40 on other new building as specified.
April 2004 - OSB #2 got bids for CAT.6 copper computer wiring/outfitting for high speed wideband intranet data.
April 20, 2004 - Special permission to have a KSC 30-year special edition for NASA with time lines of Cost Increases.
April 21, 2004 - PBS Nightly Business Reports (NBR) shows food increase 10-50%.
April 2004 - JAB Cost Index Data Book shows commodity metal charts. Nickel, carbon steel scrap, SST scrap .20 to .75/lbs. Also along with copper up big. See page 180.
April 2004 - New workman’s compensation rates go down but – we should still use 53% for Budget PT&I due to new special 99% premiums.
April 21, 2004 - USB Money Greenspan: Deflation is not a threat. S&P 500 Index takes big drop. Some commodities fall 10-20%.
April 27, 2004 - Price quote Arnold Transportation, Inc. 1-800-876-4450 Jacksonville, Fl - $1,500 per 18 wheeler tractor trailer with driver from Columbus, Ohio to KSC, Fla. Plus load and unloading cost. Approximately $1.60/mile up from $.94/mile. Call for more current quotes update for Return To Flight (RTF) for special GSE availability, some special situations may cost up to $5,000/truck load.
May 4, 2004 - Cement supplies drying up. No concrete for other new building. May 3 & 4. Concrete may go up to $500/cy in July & October, etc. Palm Beach Post. Com Rationing/Allocations may continue the rest of year.
May 6, 2004 - Cost Engineering Comments – Some reasons for big cost increases – US Dollar down 30%, scrap prices up big, some commodities up big – copper, steel, aluminum, oil, gas, asphalt, and cement. China booming 9.7% growth, last quarter, causing big demand. US growth rate up – best in 3 years, Iraq construction up, US housing market up big because of low interest rates, most types of insurance up – Medical, home, auto, etc., also transportation up as oil prices rise. But some things down – computers, PC, blinds, electronics, cell phones and long distance rates.
May 24, 2004 - ENR page 11 – Material “Cement Shortages Pressure Rates”. The south east particularly affected. Demand up 24 million tons beyond the average US production. Supply problems could last a year. ENR page 20/21 Construction Cost up 6.4%, building costs up 8.1%. Materials up 16.5% change per year. Rebar steel prices continue to soar – up 40% above a year ago.
May 28, 2004 - Another Craft Labor Rate up – Painters
May 28, 2004 - Florida Today “Cement Shortage Delays Construction” Pools will take longer and cost more.
June 2, 2004 - Central Florida Cost Report “Concrete and Steel Cost increase for now with talk of drywall. Some project waiting 30-40 days for concrete slabs, concrete may go up 20% more.” Another comment delays will cost extra escalation and time which few are figuring now.
July 7-10, 2004 - For KSC construction project use 10% for escalation for 2004, 5% for 2005, and 2006 – but do a cost analysis and get quotes for major multi-year projects that are heavy weighted in concrete, steel, Rebar (Reinforcing Steel), copper, asphalt, and aluminum. Also
scheduling delays will cost extra for time escalation.
Some considerations in this percentage escalation –labor up 7%, KSC materials up 18.8%, 3/31/04, assuming 50% labor and 50% material would average 12.9%. Other thoughts, concrete to go up 20%, rebar 20–40%, say 30%, Steel 20–40%, say 30%. However, past history shows 1971 increase of 13.8%, 1975 – up 11.8% and 1980 up 10.1%. Table page 35 & page 4, and overall average 1974 – 2003 of 4.7%

Ref. JAB Vol. 15 page 353.
June 17, 2004 Boyken International Report
“Steel Pricing out of Control” – Spring 2004
Report “Some economists predicted an impact but no one expected the increase of 40% to 60% experience in the last two months” – However steel, scrap metal, rebar and structural steel prices should stabilize as shown in graph A, B & C – Forecast.
June 18, 2004 KSC Davis Bacon General Labor Rate goes up to $19.52 with fringe.
June 28, 2004 - ENR “Inflation It’s Back” CCI up 6.2%, BCI up 8.7%, Material up 19.6%, p 22-28, 17 other indexes up also (Engineering News-Record weekly magazine cover). June 30, 2004 - KSC Cost Index Material up 28%. Labor up 1.15% Index up 13.4%.
July 1, 2004 - JAB presents “KSC Construction Cost Alert” L & M up 10-110%.
July 5, 2004 - ENR p18 Building-Productivity & Enhancements Study
July 19, 2004 - ENR CCI up 6.4% BCI up 9.0% materials up 20.9%

*See JAB about these special confidential reports

Aug/Sep 2004 - ENR’s inflation rates triple last year (page 24)
Sept. 30, 2004 - KSC Cost Index 11.69% and 23.53% per year (page 2)
Oct. 4, 2004 - ENR Magazine Construction Index up 8% change per year, Building Index up 10.3% change per year, Material Index up 22.4% change per year, See new ENR’s charts – Cement, concrete, asphalt, block

Oct. 10, 2004 Cost Engineer recommends 13% escalation for 2004, (15% - 2% for productivity increase and design enhancements) and 5% for years 2005 and 2006. But do a cost analysis and get quotes for major multi-year projects that are heavy weighted in concrete, steel, rebar, copper, asphalt, and/or aluminum etc. Schedule delays and hurricane impacts will cost extra for time escalation.
Oct. 19, 2004 - “Cost Alert Presentation” to Florida Section AACE Int. by NASA Glenn
Butts and Joe A. Brown with major comments on oil @ $55.00/BBL; Argentina Escalation Rate of 30% compared to KSC rate of 13% estimated; China continuing impact preparing for 2008 Olympics, 20 Newly planned Nuclear power plants of 1000 M.G. Watts - Billion dollars harbor & Hydro Dam.”

Various studies were presented with supporting information from various materials cost indices that escalation at the KSC was accelerating at a greater rate than previously anticipated.

At the end of the presentation that same earlier group survey was taken and it was found that in all cases people’s earlier predictions of escalation percentages had now increase.

Oct. 27-28, 2004 - Joe’s Cost Alert-Up-Date China raises interest rate (1st time in 9 years) commodities, oil, prices drop. Constructions cost escalation fears drop some.

Nov. 2, 2004 - Glenn Butts “Enr Cost Index Declines” = CCL & BCI Index numbers - chart enclosed.

Nov. 4, 2004 - President re-election confirmed, stock market goes-up. Space program continues back to the moon and mars.

Nov. 17, 2004 - “Wholesale prices soar” PPI leaped 1.7% last month driven by surging energy costs. Is inflation back? Biggest jump in nearly 15 years. CNN Money (59% worry about higher inflation) of 16,161. See Vol. XIV p. 243, Nov. 15, 2004

Dec. 31, 2004 - KSC Cost Index up 24.36% for 2004 labor up 3.12%, material up 53.98% - Finally Sept & Dec. Growth rate flatten out per KSC Index.

Feb. 14, 2005 - ENR CCI up 6.4% BCI up 8.3% and materials up 16.9%

July 18, 2005 - JAB comment on Escalation use 5.2% for escalation.

Aug. 28, 2005 - Katrina floods New Orleans after hitting Key West, Fla

Sept. 22, 2005 - JAB Cost Alert #2 consider 10% escalation for 2005 - 2008 due to Katrina and Rita hurricane impact on oil, natural gas, and building materials and construction labor impact, etc. Get quotes and make analysis for major year project.

Sept. 30, 2005 - Glenn Butts KSC Cost Index, pg. 16 & 17

The Florida construction boom is showing signs of easing and the preponderance of the 2004 hurricane damage repairs have occurred. This would normally be a precursor to a leveling off and possible reduction in the cost index. However the recent hurricane could quell the expected relief, generally hurricanes only affect the local area were the damage actually occurred.

However Hurricane Katrina was a monumental event which inflicted substantial damage in four states, and minor damage in several more, early estimates are for $100 to 200 BILLION dollars in damage.

Expect higher prices for steel, roofing products, concrete, insulation, drywall & copper as a result of heavy consumption during the rebuilding process, stockpiling of materials, and damage to manufacturing facilities. For example Air Products & Chemicals facilities sustained substantial damage. They are the primary supplier of liquid hydrogen, a critical component in the steel production processes, to the steel industry.

Labor prices could also rise since workers will be enticed to the storm ravaged area by the lure of higher wages, and all the overtime they can work. Ergo KSC could be affected by labor and material shortages, which will transform into increased costs. The repercussions will not be a brief spike, but a plateau that will ramp up rapidly and should begin tapering off sometime in 2007.

The Exploration Program is gearing up; studies and designs for a massive construction program are beginning. Early indications are for two major construction phases, the first will be for the Crew Exploration Vehicle (CEV) & Cargo Launch Vehicle (CLV) which are tentatively slated for inaugural launch in 2011, the second is for the Shuttle Derived Inline Heavy (SDIL).

If the CEV program is to meet the initial schedule $500 Million to $1 Billion in construction contracts will be awarded, and completed between 2007 & 2010. After the last shuttle flight currently slated for 2010 the second phase will be work for the SDIL will continue until 2015. The exploration construction expenditures are expected to augment the existing “normal” construction efforts, not replace them, which when added to the exploration construction program equates to $2 Billion dollars in KSC construction of facilities (CoF) work between 2006 and 2020. Substantial additional expenditures will be required for research and development (R&D) functions that will be required to activate the facilities, and the fabrication of ground support equipment (GSE) which should add an additional $1 to $2 Billion into the local economy. Now that you have been burdened...
2. Until US recession/major depression in housing market
3. Until successful use of Helium 3 as a US electrical power source. This may take several years.

Chart #6 Cost index comparison. ENR, CCI, BCI, KSC cost index & CPU shows escalation 1974 with projection to 2016 with noted economical, political, weather milestones

Chart #7 - KSC annual escalation 1974-2020 using JAB computerized excel cost escalation program. $2000 - $17,000 -- worst case scenario to $22,500

Chart #8 - Report by John Janacek of CW driver escalation 12%
What is presently being done to keep escalation down?

- Increased productivity, examples: computerization, electronic energy, efficiency
- CPI consistency under estimates, cost increases to keep social security, labor, pension down - medical, property taxes, insurance, homeowners, etc.

**COST ALERT**

Now the surprising, confidential, sensitive background - How did the author project the cost escalation alert months before the usual daily and weekly reports? The surprise was a valuable use of the London Financial Times Daily with independent, global commodities, currency and construction reports of increasing demand and lack of increasing supplies, especially China and Indian growth. The sharing of Cost Data between USA, NASA, KSC Support Contractors, vendors and suppliers and bidding problems due to hurricanes, disasters, etc. The KSC Cost Index TR1511, 1974-2007 was especially valuable with labor rates and materials (240 items), productivity and workman’s compensation rates. The Florida Section and AACE International “Cost Escalation and Labor Productivity - What We Can Do About It” and what we did about it - meeting programs, surveys, seminars, and symposiums since 1970 and AACE local and national members reports and alerts, etc. Also, the over 300 education and estimating tools created, developed, tested, and documented by KSC, USA, CCCI, and JAB teamwork since 1963-2007. Therefore a special thank you to all, especially, Susan, Dallas, Mel Jones, Gene, Glenn, Steve, Mike, and Phil and our team work members. See lobidder video and bid strategy DVD “How Successful Contractors Solved High Cost Escalation Problem - Runway and Processing Fac.

What are the newest and/or most exciting and important of the 300 Cost Engineering Tools?

1. **Over 300 KSC Cost Indexes** provide experience and back up, early cost alert for construction and GSE Cost Escalation, latest dated December 30, 2006 (one of the most important tools)
3. Near 500 systems summaries, facilities, GSE, processing, pads, over fifty different type of projects
4. 21 Computer Templates, Budgets, Design, Preliminary and Detailed Estimates, etc.
6. Estimating Fiber Optics Cable Method, fast and easy
7. Remote Automated Panels, Man-hours, Method, fast and easy, $10,000-$300,000
8. Cost per component, fast and easy, $1,000-$2,500
9. Fine tuning, number of bidders concept, bid strategy
10. Construction Management Analysis Method
11. Cost Index Analysis Matrix for design, productivity, etc.
12. Cost Escalation Alert Analysis, four new technical papers
13. Launch Pad Cost Comparisons, $20 million to $300 million dollars
14. Detailed Launch Pad Cost Breakdown, $1.2 billion dollars
15. VAB Cost Studies, $160 million to $2 billion dollars
SUMMARY

What should be used for cost escalation for the NASA KSC Space Program to the Moon & Mars. Consider using 6% to 10% per year, but on major multi-year that are heavy weighted in concrete, steel, rebar, copper, asphalt & aluminum do a cost analysis, get quotes on major cost items. Remember that impact, scheduling delays with cost extra for time extensions & C.O.’s

A special thank you to AACE, KSC, USA, and team members for your support.

Joseph A. Brown, CCE President
Con$truction Co$t Con$ultant, Inc.
P.O. Box 54053 – 1695 Vega Avenue
Merritt Island, Florida  32954-3175
References

3. Janacek, John - Construction Cost Going Through the Roof, 2006 Public Works Officers/Institute, March 1, 2006, pg. 97, 2 mg file
Joseph A. Brown, CCE, President CCCI
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1962 to Present. Con$truction Co$t Con$sultant, CCE President. Consultant services, writing, training, educational seminars, cost engineering, cost estimating, preparing, reviewing, cost analysis of over $10 billion of cost estimates for facilities, construction, GSE, activation, etc. With over 250 Aerospace cost engineering tools, books, CD ROM's, DVD's, videos, cost studies and new exciting, conceptul estimating methods. Over 2000 seminars students from six continents. Space Works Engineering Inc. (SEI) FGOA/D4OPS contract, July 19, 2003 thru Jan. 15, 2004 with near $4 billion of conceptual cost estimates and analysis.

Joseph A. Brown created a world class total Aerospace Co$t Estimating, Co$t Engineering, CM for Facilities, Construction, GSE system and activation. This system and process has proven performance and results, saving billions of dollars with near 300 unique tools, including over 30 new, exciting tools, technical papers, and cost studies for space exploration to the Moon, Mars, and the Universe. This world class cost engineering system was created from five tools in 1963 by JAB and his KSC teamwork effort.

July 1, 1996 – October 28, 2005. Lockheed Martin/USA Space Flight Operations Contract (SFOC) as Senior Engineer, Certified Cost Engineering, Cost Consultant for facilities and ground support equipment (GSE) and construction, preparing, reviewing, cost analysis, (over $10 billion of cost estimates), modification management, training, seminars and computerization. These important estimating tools:

- Helped reduce change order (C.O) cost from 52% to 12.50% of bid cost with 150 ways to reduce C.O. cost on over #300,000,000 of Construction and GSE
- Helped improve design performance, cost and schedule performance with large bonuses to KSC team work members through cost engineering, construction management, cost control, planning and scheduling, cost analysis, computerization, and incentive contract, etc.


1963 – 1995. (GS11/14) National Aeronautics and Space Administration (NASA) Kennedy Space Center (KSC), Lead Cost Engineer, Senior Advisor and Coordinator for development of cost engineering and estimating for KSC facilities, equipment, and construction. Prepared and reviewed over $17 billion of cost estimates, including pre-conceptual space shuttle launch facilities at six locations, Oct. 1970 for $7.44 billion, ELV $5.9 billion and LC39 VAB and Launch Pad over $200 million, 1963-1970. See the website for detail resume (www.lobidderviedo.com) or contact me at lobiddervideo@cfl.rr.com
Cost Escalation, Tools, Facilities GSE for Space Moon & Mars

Space Vision Congress
Florida Solar Energy Center
BCC/UCF Campus, Cocoa, Florida
April 26-28, 2007

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- List of Facilities & GSE, 5-15 Bill Construction Program for Constellation to Moon and Mars

- List of 30 of 300 educational estimating tools necessary for the budget, design, construction and activations for Moon & Mars program
BACKGROUND

• The Author has been an important team leader in the war against construction cost escalation through
  
  – education,
  – lecturing,
  – training,
  – writing technical papers,
  – improving labor productivity through measurement and surveys,
  – and improving labor productivity by creating and developing over 300 education/estimating cost engineering tools/spin-offs for faster, better, and cheaper engineering (see 9/8/70 letter), chart on survey and votes 1970-2005 for reducing cost escalations.
Background (cont)

• But most importantly, the draft chart date, 1/21/98, shows escalation reduced from 13.8% to a steady 1.6 to 3.76 rate - a great improvement, and one of the major reasons for the economic boom and prosperity, and labor productivity improvement since 1985.

• This is a major accomplishment of the teams of engineers, constructors, aerospace, and American people. Note the letter, charts, and surveys are part of Joe A. Brown’s cost engineering seminar books; volumes 2, 3, and 7, which are copyrighted by Con$truction Co$t Con$ultant, Inc.

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Project Orion Overview
And
Prime Contractor Announcement

Skip Hatfield
Orion CEV Project Manager

August 31, 2006
Orion Advances the Human Exploration Vision

- Orion is the next generation crew piloted spacecraft
  - Human access to Low Earth Orbit …
  - … and to the Moon and Mars

- Orion has a talented management team and workforce which utilizes unique personnel and facility strengths from across NASA and industry

Orion to meet the mission
- Finalize requirements
- Mature the technology
- Design the Systems
- Test the Systems
- Prepare for first flight operations

- We are committed to meeting the national priorities for Orion!
Lunar Mission
Capable of Space Station Missions
Orion Launch Abort System

- Attitude Control Motor
- Jettison Motor
- Abort Motor
- Boost Protective Cover
Orion Service Module
Shuttle Derived Launch Vehicle Concepts

William J. Rothschild and Debra A. Bailey (Boeing, NASA Systems),
Edward M. Henderson (NASA/JSC), and Chris
Crumbly (NASA/MSFC)

For Presentation at the AIAA Joint Propulsion Conference

Tucson, Arizona July 10 - 13, 2005
Figure 5. The in-line medium-lift SDLV option uses mature, human-rated propulsion elements for a high-reliability CEV launcher.
Figure 8. The in-line heavy-lift SDLV option offers massive payload capabilities built on mature propulsion elements.
Facilities & Ground Support Equipment (GSE)

• Some KSC facilities are LC-39 Launch Area including:
  – VAB, new ½ - full cost dollars $1-3 Billion – time 5-8 years
  – LCC, refurb
  – OPF’s,
  – two launch pads, new cost “QROME” $1-2 Billion – time 3-6 years
  – support buildings,
  – crawler transporters,
  – three launch platforms “MLP’s”,
    • may require 3-6 more for Solar Electrical Satellite
  – crawl-away,
  – park sites,
  – SSPF, O&C, RPSF, VPF, LETF, GSE (items used to transport, access, handle, protect, service, and check-out flight hardware/software on the ground such as; RSS, platforms, panels, ECS Systems, cranes, hoists, lifting devices, and auto couplers)

See JAB Website www.lobiddervideo.com, Estimating Tools for pictures of GSE and facilities, also see JAB Vols. 14 and 15, pgs. 18-26, and 96-99. Also see website Searchable Vol. 18
Pads ‘A’ & ‘B’ and Proposed Pad ‘C’ – Background LC-39 Overview
Site Map/Overview – Proposed New Pads / Facilities 39C/opt, Complex 42

New Runway

New Pad C (Shown Location per 1967)

Pad B

Pad A

Complex 42

Complex 41

Complex 40

New (½) VAB

New OPF IV Mods Add SSME

New OSB II & Osb III

Industrial Area

O&C Building

Space Station Facility Mods
Launch Complex 39 – Pad A

Summary

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Significant KSC Cost Drivers

- Electrical - Special Lightning Protection, Emergency Power, Uninterruptible Power
- Acid Disposition, Epoxy, Polyurethane Coating
- High pressure Panels, Vacuum jacket, Hypergolic / Cryogenic, Cranes, Brakes, and Controls
- Electrical - Bonding and Grounding
- Sound Suppression for Solid Boosters
- PCR - Clean Rooms
- GN2 - Explosion Proof
- Special underground utility tunnels for Hi-pressure piping & cable trays
- Weather Extremes Hot to freezing (requires extra insulation and protection)
Significant KSC Cost Drivers

Special Construction
Access Flooring,
Mechanical Systems,
S.S. pipe, ECS Duct, Welding

Inspections and
quality Control
Reliability Redundancy

Tolerance Assembly
Fabrication

Clean room, Deluge

Corrosion
Protection

Acid Disposition
Epoxy, Polyurethane Coating

Wind Loading

Wet Lands &
Toxic disposal Permitting

Lines of Site
S Band

Security (PACAS)
VAB Interior Concept Illustration
Suspended Concrete Slab Forming – 520 Feet
Orbiter Processing Facility

- Orbiter Processing Facility – Phase 1
- Way #67 Special sub-contractor team work – (a “closed shop” team work effort helped them win this bid). Project Manager for Briscoe later confirmed this was a money maker for them (see system summary)
Artist Rendering – SSPF Space Station Processing Facility, also for Constellation
SRB Facility – Under Budget on Schedule
SRB Facility – Under Budget on Schedule (cont’d)
What is GSE? As Shown in KSC-STA-67, Rev. A 6/19/90

• **Ground Support Equipment (GSE)**
  – Items or units used to transport, access, handle, protect, service, or checkout flight hardware/software on the ground

• **Ground Support Equipment Item Description (GSEID)**
  – The GSEID defines and describes the physical and functional characteristics of the system / subsystem / equipment to be design, developed, procured, fabricated / assembled, tested, checkout and used
  – All interfaces with other systems and equipment, flight and ground, are identified
  – Performance requirements are included and verification testing identified

• **KSC SPEC G-0003 July 5, 1977**
  – Further GSE function designations (TR 1287)
    • Servicing
    • Checkout & Test
    • Handling & Transportation
    • Auxiliary
    • Uncategorized
Examples of GSE: CCS

- Computer Control Systems (CLCS),
- Hardware: Computer processing unit, printers, display monitors storage devices
- Software: Programs – “People Soft”, “Magnum”, KIMS
- Training: Video Instruction
- Electronic / Electrical: Cabling, Control, Sensors, Racks, Solenoids, Motors, Power, Communication, Instrumentation, and Video Cameras
Examples of GSE: ECS

- Environmental Control Systems, Portable ECS Units HEPA Filters, Clean Room, Equipment Pumps, Compressors SS Double Wall Ducts, and ECLSS
Example of GSE: Panels

- GHe, GN2, and Breathing Air
Examples of GSE: Piping

- Vacuum Jacket, High pressure, Tubing, Flexible hoses, and Double wall stainless
Examples of GSE: Architectural

- Environmental Enclosure on end of Swing Arm Canisters
Examples of GSE: Machinery

- Rotating Swing Arms, Cranes Hoist, Lifting Devices and Transporters
Examples of GSE: Structural – KSC Shuttle GSE

- OPF, VAB PCR / RSS, FST Aft Platforms, and Orbiter Access Platforms
Agenda

- Background – Time-line (Labor and Material up 10 to 110%):
- Cost Escalation and Labor Productivity Survey
- Construction Cost Escalation Chart – 1960 thru 2004 (from JAB Volume III)
- Cost Index Comparison – ENR CCI, ENR BCI, KSC, and Consumer Price Indices
- Construction Economics
- Interest Rate Comparison – to Average Escalation Factor
- KSC Quarterly Construction Cost Index
- KSC Annual Construction Cost Index thru 2004
- KSC Escalated Construction Cost Index thru 2020
- Annual Escalation Average Increase with Projections
- Index Information
- General Comments – Estimated Escalation Rates
- KSC Annual Escalation 1974 – 2020 (JAB Computerized Cost Escalation Program)
- Construction Economics
- Summary - Cost Engineering Recommendations
- Sample Estimate Form ECBC
- Sample Estimate Form 1510
### Background – Time-line of Events (Labor and Material up 10 to 110%)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 15, 2003</td>
<td>Concrete going up for 2004</td>
</tr>
<tr>
<td>Jan. 23, 2004</td>
<td>“Wow” 8 craft labor rates go up</td>
</tr>
<tr>
<td>Feb. 2, 2004</td>
<td>USA CofF labor up 7% See J.A.B. for details*</td>
</tr>
<tr>
<td>March 31, ‘04</td>
<td>KSC Cost Index Notes Big Jump in Mat. Prices/labor</td>
</tr>
<tr>
<td>April 1, 2004</td>
<td>JAB Cost Alert Steel, Copper, Concrete, Aluminum, oil, Lumber &amp; Labor, etc., please consider 4-10% per year for escalation, and do a cost analysis on major multi-year projects.</td>
</tr>
<tr>
<td>April 14, 2004</td>
<td>USA gets copy of March 25, 2004 letter* to all distribution steel scrap up 60% in one year and 110% in 2 years – Pipe and fittings priced at delivery only. No more holding price 30 days to 6 months. Hard to bid projects. One comment some Government contracts may have to include Escalation clause.</td>
</tr>
<tr>
<td>April 19, 2004</td>
<td>More trade labor increase electrical – 2nd time this year. Davis Bacon – April 2, 2004 new labor rates with PT&amp;I from $20.95/hr truck driver to $47.97/hr for elevator construction. Ironworkers to $44.52, electricians to 41.18, sprinkler fitter to $44.40, pipe fitter to $41.91) (see APB Volume 16, page 39)</td>
</tr>
<tr>
<td>April 2004</td>
<td>New Workman’s Compensation Rates (WCR) go down but --- we should still use 55% for Budget PT&amp;I due to new special 99% Premiums. (APB Volume page 37 – would raise WCR to 83% from 41.5% or PT&amp;L of 94.73% for JUI rate with premium)</td>
</tr>
</tbody>
</table>
Background – Time-line of Events (Labor and Material up 10 to 110%)
(continued)

May 6, 2004    Cost Engineering Comments – Some reasons for big cost increases – US Dollar down 30%, scrap prices up big, some commodities up big – copper, steel, aluminum, oil, gas, asphalt, and cement. China booming 9.7% growth, last quarter, causing big demand. US growth rate up – best in 3 years, Iraq Construction up, US housing market up big because of low interest rates, most types of insurance up – Medical, home, auto etc. also transportation up as oil prices rise. But some things down – computers, PC, blinds, access flooring, electronics, cell phones and long distance rates.

May 24, 2004    ENR page 11 – Material “Cement Shortages Pressure Rates”. The south east particularly affected. Demand up 24 million tons beyond the average US production. Supply problems could last a year. ENR page 20/21 Construction Cost up 6.4%, building cost up 8.1%, and Materials up 16.5% change per year. Rebar steel prices continue to soar – up 40% above a year ago.

June 17, 2004    Boyken International Report “Steel Pricing out of Control” Spring 2004 Report “Some economists predicted an impact but no one expected the increase of 40% to 60% experience in last two months” - However steel, scrap metal, rebar and structural steel prices should stabilize as shown in graph – Forecast
**Cost Escalation and Labor Productivity Survey**

- **What can we do about it?**

<table>
<thead>
<tr>
<th>HISTORICAL SUMMARY OF VOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Education of the Consumers, Unions and Students</td>
</tr>
<tr>
<td>2. More Efficient Management and Methods &amp; Computerization</td>
</tr>
<tr>
<td>3. Political Activity for Legislative Action-Right to Work, Regional Bargaining, Common Expiration of Labor Contracts, etc.</td>
</tr>
<tr>
<td>4. Improved Engineering Design</td>
</tr>
<tr>
<td>5. Owner Education as started by Anti-Inflation Roundtable</td>
</tr>
<tr>
<td>6. Upgrading Building Codes</td>
</tr>
<tr>
<td>7. Industrial Consolidation*</td>
</tr>
</tbody>
</table>

* Added during discussion at Montreal presentation

** Highest total votes to date

Reference JAB Volume III – Page 21

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Space Congress - Cost Escalation, Tools, Facilities and GSE for Moon & Mars Program

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April 7, 2007
Cost Index Comparison - ENR CCI, ENR BCI, KSC, and Consumer Price Indices (By NASA Program Analysis)

R² = 98.35%
R² = 98.72%
R² = 97.87%
R² = 84.92%

Cost Index Comparison

Prior Years Below Average

4 Hurricanes 2004
Asian Impact 2004
Gulf War 1991

Oil Prices Rise 250% 1yr 1974

30 year Mortgage Rates Peak @16.6% 1981
Berlin Wall Falls 1989

All Data Mean Trend

ENR CCI Trend
ENR BCI Trend

TR-1511 Linear
TR-1511

5,000
6,000
7,000
8,000
9,000
10,000


* TR 1511 Data JAB Vol. 5 p 97-109 & KSC Cost Index 3/31/04: Index Numbers 2000 = $1,000 Labor plus $1,000 Materials Jan. 1974 (see JAB Ref. #90 & see p. 10)

R² = Percent Probability the Trend Line is Correct . Derived from the Pearson product moment correlation coefficient
KSC Annual Construction Cost Index
• Escalation thru 2020 showing annual growth
Annual Escalation Average Increase with Projections (by NASA Program Analysis)

Annual Escalation Average Increases

- CCI
- BCI
- TR-1511

<table>
<thead>
<tr>
<th>Period</th>
<th>CCI</th>
<th>BCI</th>
<th>TR-1511</th>
<th>Projected 05</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975 to 2003</td>
<td>4%</td>
<td>4%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>1975 to 1981</td>
<td>8%</td>
<td>8%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>1993 to 2003</td>
<td>2%</td>
<td>2%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Prior 12 MO</td>
<td>15%</td>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected 05</td>
<td>5%</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Index Information (by NASA Program Analysis)

- **ENR CCI INDEX**: 200 hours of common labor at the 20-city average of common labor rates, plus 25 cwt of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price.

- **ENR BCI INDEX**: 66.38 hours of skilled labor at the 20-city average of bricklayers, carpenters and structural ironworkers rates, plus 25 cwt of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price.

- **KSC TR-1511 index**: is compiled using the average price of 29 construction material items & the weighted average of 19 skilled trades @ KSC Davis Bacon Wage Rates.

- **Consumer Price Indexes (CPI)** represents changes in prices of all goods and services purchased for consumption by urban households. User fees (such as water and sewer service) and sales and excise taxes paid by the consumer are also included. Income taxes and investment items (like stocks, bonds, and life insurance) are not included. It is the most widely used measure of inflation; business executives, labor leaders and other private citizens use the index as a guide in making economic decisions. Prices for the goods and services used to calculate the CPI are collected in 87 urban areas throughout the country and from about 23,000 retail and service establishments. Data on rents are collected from about 50,000 landlords or tenants.
General Comments – Estimated Escalation Rates (by NASA Program Analysis)

- Escalation rates were calculated using a Neural Network, which is a type of artificial intelligence. It uses sophisticated algorithms to analyze historical data, look for patterns & trends, to predict future escalation rates. This is a very CPU intensive process that required three (3) days and over two (2) billion calculations to compute.
- Information entered into the Neural Network included thirty years of historical data obtained from The Engineering News Record (ENR) Building Cost Index (BCI) Construction Cost Index (CCI) and the Kennedy Space Center Construction Cost Index (TR1511), as well as the Consumer Price Index (CPI). All four indexes were analyzed, and the data obtained from the calculations were averaged to obtain the new escalation rates.
- **Are the projections correct? Time will tell**, but a statistical analysis derived from Pearson Product moment correlation coefficient on the historical data indicates the projections appear to be well within the probability range.
- “Just be advised the Projections are Estimates”
• Cost Indexes

**Construction Cost Index**
Despite intense materials price pressure, annual inflation measured by the CCI slipped from 6.4 to 6.2%.

<table>
<thead>
<tr>
<th>20-CITY: 1913=100</th>
<th>JUNE 2004 INDEX VALUE</th>
<th>% CHG. MONTH</th>
<th>% CHG. YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTRUCTION COST</td>
<td>7109.40</td>
<td>+0.6</td>
<td>+6.2</td>
</tr>
<tr>
<td>COMMON LABOR</td>
<td>14883.55</td>
<td>+0.3</td>
<td>+3.2</td>
</tr>
<tr>
<td>WAGE $/HR.</td>
<td>28.28</td>
<td>+0.3</td>
<td>+3.2</td>
</tr>
</tbody>
</table>

**Materials Cost Index**
Lumber, steel and cement prices all increased this month, pushing the MCI 20% above a year ago.

<table>
<thead>
<tr>
<th>20-CITY: 1913=100</th>
<th>JUNE 2004 INDEX VALUE</th>
<th>% CHG. MONTH</th>
<th>% CHG. YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>2344.60</td>
<td>+2.2</td>
<td>+19.6</td>
</tr>
<tr>
<td>CEMENT $/TON</td>
<td>83.83</td>
<td>+0.7</td>
<td>+1.3</td>
</tr>
<tr>
<td>STEEL $/CWT</td>
<td>31.27</td>
<td>+1.9</td>
<td>+21.3</td>
</tr>
<tr>
<td>LUMBER $/MBF</td>
<td>530.65</td>
<td>+2.7</td>
<td>+20.1</td>
</tr>
</tbody>
</table>

**Building Cost Index**
Material price inflation has driven the BCI 8.7% above 2003’s level. A year ago, annual escalation was just 1.5%.

<table>
<thead>
<tr>
<th>20-CITY: 1913=100</th>
<th>JUNE 2004 INDEX VALUE</th>
<th>% CHG. MONTH</th>
<th>% CHG. YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING COST</td>
<td>3995.76</td>
<td>+1.0</td>
<td>+8.7</td>
</tr>
<tr>
<td>SKILLED LABOR</td>
<td>6698.41</td>
<td>+0.4</td>
<td>+3.3</td>
</tr>
<tr>
<td>WAGE $/HR.</td>
<td>37.18</td>
<td>+0.4</td>
<td>+3.3</td>
</tr>
</tbody>
</table>
Construction Economics

- Material Price Indexes

source: ENR Construction Department

Source: ENR Construction Department

Source: ENR Construction Department

Source: ENR Construction Department

Source: ENR Construction Economics Department 20-city average price percent change June v.s. June
• The truth about steel pricing / availability
Inflation Rate Triples Last Year’s Pace

• According to ENR Magazine:
  – “Preliminary data indicate that inflation has not yet peaked, with several indexes already breaching the double-digit barrier. ENR’s Building Cost Index rose from a 9.0% annual rate in July to 10.4%”

<table>
<thead>
<tr>
<th>Builder’s Construction Cost Indexes</th>
<th>July 2003</th>
<th>Change Year (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Purpose Cost Indexes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENR 20-city: Construction Cost(^1)</td>
<td>623.33</td>
<td>6.4</td>
</tr>
<tr>
<td>ENR 20-city: Building Cost(^1)</td>
<td>545.24</td>
<td>9</td>
</tr>
<tr>
<td>Commerce Dept.: Fixed weighted(^7)</td>
<td>129.50</td>
<td>8</td>
</tr>
<tr>
<td>Commerce Dept.: Price Deflator(^7)</td>
<td>130.20</td>
<td>8.3</td>
</tr>
<tr>
<td>BuRec: General Building(^2)</td>
<td>243.00</td>
<td>N/A</td>
</tr>
<tr>
<td>Factory Mutual: Industrial(^3)</td>
<td>198.00</td>
<td>11.1</td>
</tr>
<tr>
<td>Handy-Whitman: General Building(^4)</td>
<td>331.50</td>
<td>N/A</td>
</tr>
<tr>
<td>Lee Saylor Inc: Material Labor(^4)</td>
<td>619.61</td>
<td>8.1</td>
</tr>
<tr>
<td>Means: Construction Cost(^5)</td>
<td>132.00</td>
<td>8.9</td>
</tr>
<tr>
<td><strong>Selling Price Indexes-Building</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Austin Co: Industrial</td>
<td>516.85</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>M&amp;S Boechkh Valuation Indexes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marshall &amp; Swift: Industrial(^1)</td>
<td>133.80</td>
<td>10.2</td>
</tr>
</tbody>
</table>

\(^1\)Base: 1967=100, \(^2\)Base: 1977=100; \(^3\)Base: 1980=100; \(^4\)Reinforced building concrete six region average; \(^5\)Base: 1993=100; \(^6\)Base: 1958=100; \(^7\)Base: 1992=100; \(^8\)Base: April 2001=100
Cost Indexes

Construction Cost Index
The CCI followed September's 1.5% jump with another 0.2% increase, keeping annual escalation at 8%.

<table>
<thead>
<tr>
<th>20-CITY: 1913=100</th>
<th>OCT. 2004 INDEX VALUE</th>
<th>% CHG. MONTH</th>
<th>% CHG. YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTRUCTION COST</td>
<td>7313.88</td>
<td>+0.2</td>
<td>+8.0</td>
</tr>
<tr>
<td>COMMON LABOR</td>
<td>15247.11</td>
<td>+0.1</td>
<td>+4.8</td>
</tr>
<tr>
<td>WAGE $/HRL</td>
<td>23.97</td>
<td>+0.1</td>
<td>+1.4</td>
</tr>
</tbody>
</table>

Building Cost Index
Annual inflation measured by the BCI remained above 10% for the second consecutive month.

<table>
<thead>
<tr>
<th>20-CITY: 1913=100</th>
<th>OCT. 2004 INDEX VALUE</th>
<th>% CHG. MONTH</th>
<th>% CHG. YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING COST</td>
<td>4128.86</td>
<td>+0.6</td>
<td>+10.3</td>
</tr>
<tr>
<td>SKILLED LABOR</td>
<td>6874.35</td>
<td>+0.5</td>
<td>+4.2</td>
</tr>
<tr>
<td>WAGE $/HRL</td>
<td>38.15</td>
<td>+0.5</td>
<td>+4.2</td>
</tr>
</tbody>
</table>

Materials Cost Index
Lumber, cement and steel prices all moved higher, keeping the MCI 22% above 2003's level.

<table>
<thead>
<tr>
<th>20-CITY: 1913=100</th>
<th>OCT. 2004 INDEX VALUE</th>
<th>% CHG. MONTH</th>
<th>% CHG. YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>2451.57</td>
<td>+0.8</td>
<td>+22.4</td>
</tr>
<tr>
<td>CEMENT $/TON</td>
<td>84.83</td>
<td>+0.6</td>
<td>+2.5</td>
</tr>
<tr>
<td>STEEL $/CWT</td>
<td>32.64</td>
<td>-0.1</td>
<td>+26.3</td>
</tr>
<tr>
<td>LUMBER $/MBF</td>
<td>559.09</td>
<td>+1.9</td>
<td>+25.5</td>
</tr>
</tbody>
</table>
ENR Materials Price Indexes

**Portland Cement**
Prices have increased in four of the last six months.

**Ready-Mix Concrete**
September’s 1.7% price increase is holding firm.

**20-City Average**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Price</th>
<th>% Chg. Mo.</th>
<th>% Chg. Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Paving</td>
<td>ton</td>
<td>186.43</td>
<td>+0.3</td>
<td>+6.2</td>
</tr>
<tr>
<td>Cutback, MC800</td>
<td>ton</td>
<td>249.26</td>
<td>+0.9</td>
<td>+6.2</td>
</tr>
<tr>
<td>Emulsion, Rapid Set</td>
<td>ton</td>
<td>205.77</td>
<td>+1.0</td>
<td>+9.1</td>
</tr>
<tr>
<td>Slow Set</td>
<td>ton</td>
<td>206.89</td>
<td>+1.0</td>
<td>+8.9</td>
</tr>
<tr>
<td>Portland Cement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type one</td>
<td>ton</td>
<td>85.08</td>
<td>+0.3</td>
<td>+2.8</td>
</tr>
<tr>
<td>Masonry Cement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-lb bag</td>
<td>bag</td>
<td>5.60</td>
<td>+0.2</td>
<td>+2.6</td>
</tr>
<tr>
<td>Gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2” down to 3/4”</td>
<td>ton</td>
<td>10.31</td>
<td>0.0</td>
<td>+2.3</td>
</tr>
<tr>
<td>3/4” down to 3/8”</td>
<td>ton</td>
<td>10.39</td>
<td>0.0</td>
<td>+4.7</td>
</tr>
<tr>
<td>Crushed Stone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base course</td>
<td>ton</td>
<td>8.12</td>
<td>0.0</td>
<td>+4.5</td>
</tr>
<tr>
<td>Concrete course</td>
<td>ton</td>
<td>8.29</td>
<td>0.0</td>
<td>+1.4</td>
</tr>
<tr>
<td>Asphalt course</td>
<td>ton</td>
<td>8.86</td>
<td>0.0</td>
<td>-0.3</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>ton</td>
<td>7.69</td>
<td>0.0</td>
<td>+5.7</td>
</tr>
<tr>
<td>Masonry</td>
<td>ton</td>
<td>8.22</td>
<td>0.0</td>
<td>+0.1</td>
</tr>
<tr>
<td>Concrete Ready-Mix</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,000 psi</td>
<td>cy</td>
<td>76.94</td>
<td>0.0</td>
<td>+2.8</td>
</tr>
<tr>
<td>4,000 psi</td>
<td>cy</td>
<td>80.14</td>
<td>0.0</td>
<td>+2.5</td>
</tr>
<tr>
<td>5,000 psi</td>
<td>cy</td>
<td>84.55</td>
<td>0.0</td>
<td>+2.6</td>
</tr>
<tr>
<td>Standard Modular Brick</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Block</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal-weight 8” x 8” x 16”</td>
<td>C</td>
<td>118.60</td>
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<td>Lightweight: 8” x 8” x 16”</td>
<td>C</td>
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<td>12” x 8” x 16”</td>
<td>C</td>
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<td>Masonry Lime</td>
<td>ton</td>
<td>190.81</td>
<td>+0.1</td>
<td>+2.1</td>
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</table>
Summary – Cost Engineering Comments

Based on previous charts and 50 years of estimating cost engineering experience

- **June 7-27, 2004** For KSC construction projects use 10%* for escalating for 2004, & 4% for 2005, and 2006 – but “Do a cost analysis and get quotes for major multi-year projects that are heavy weighted in concrete, steel Rebar (Reinforcing Steel), copper, asphalt, and aluminum”.

  - Some considerations in this percentage for escalation-labor up 7%, KSC materials up 18.8% 3/31/04, assuming 50% labor and 50% material would average 12.9%

  - Other thoughts, concrete to go up 20%, rebar 20-40%, steel 20-40%

  - However, past history shows 1971 increase of 13.8%, 1975 – up 11.8% and 1980 up 10.1%. (see chart #5 Cost Escalation 1960-2004, chart #7 – shows about 11% for 2004, and productivity increase May offset 1% to 3% of cost increase, June 27,2004)

  - Now 13% for FY 2004 applies to previous construction estimates for future projects made prior to July 1, 2004
Update & Cost Engineering Recommendation

August / September:
- KSC construction repairs $100 million plus

September 27, 2004 – ENR’s inflation rates triple last year (page 24)

September 30, 2004 – KSC Cost Index 11.69% and 23.53% per year (pg 2)

October 4, 2004 – ENR Magazine Construction Index up 8% change per year
Building Index up 10.3% change per year. Material Index up 22.4% change per year. See new ENR’s charts-Cement, concrete, asphalt, block and inflation plus

October 10, 2004 cost engineer recommends 13% escalation for 2004, (15%-2% for productivity increase and design enhancements) and 5% for Yr. 2005 and Yr. 2006.
- But do a cost analysis and get Quotes for major multi-year projects that are heavy weighted in concrete, steel, rebar, copper, asphalt, and/or aluminum et
- Schedule delays and hurricane impacts will cost extra for time escalation
October 19, 2004 “Cost Alert Presentation” to Florida Section AACE International by NASA’s Glenn Butts and Joe A Brown - Major comments on oil @ $55 / barrel
- Argentina escalation rate of 30% - compared to KSC’s rate of 13% (estimated)
- China’s continuing impact – preparing for ‘2008’ Olympics, 20 newly planned nuclear power plants and 1,000 MG watt
- billion dollar Harbor & Hydro Dam
- Various studies were presented with supporting information from various materials cost indices that escalation at the KSC was accelerating at a greater rate then previously anticipated
- At the end of the presentation that same earlier group survey was taken and it was found that in all cases people’s earlier predictions of escalation percentages had now increase

October 27-28, 2004 – Joe’s cost alert up date
- China raises interest rate (1st time in 9 years)
- Commodities, oil prices drop, construction cost escalation fears drop same

November 2, 2004 – Glenn Butts “Engineering Cost Index” declines - CCI and BCI index numbers chart enclosed
Update & Cost Engineering Recommendation

November 4, 2004 – President Re-election confirmed
Stock market goes up
Space Program continues back to the Moon and Mars

Nov. 17, 2004 - “Wholesale prices soar” PPI leaped 1.7% last month driven by surging energy costs.
Is inflation back? Biggest jump in nearly 15 years.
CNN Money (59% worry about higher inflation) of 16,161. See Vol. XIV p.
243, Nov. 15, 2004

Dec. 31, 2004 - KSC Cost Index up 24.36% for 2004 labor up 3.12%, material up 53.98% -
– Finally Sept & Dec. Growth rate flatten out per KSC Index.

Feb. 14, 2005 - ENR CCI up 6.4% BCI up 8.3% and materials up 16.9%

July 18, 2005 - JAB comment on Escalation use 5.2% for escalation.

Aug. 28, 2005 - Katrina floods New Orleans after hitting Key West, Fla

Sept. 22, 2005 - Consider 10% escalation for 2005-2008 due to Katrina & Rita hurricane
– impact on oil, natural gas, and building materials and construction labor impact, etc.
– Get quotes and make analysis for major year project.
• **Sept. 30, 2005** - Glenn Butts KSC Cost Index, pg. 16 & 17
  
  – The Florida construction boom is showing signs of easing and the preponderance of the 2004 hurricane damage repairs have occurred. This would normally be a precursor to a leveling off and possible reduction in the cost index. However the recent hurricane could quell the expected relief, generally hurricanes only affect the local area were the damage actually occurred.
  
  – However Hurricane Katrina was a monumental event which inflicted substantial damage in four states, and minor damage in several more, early estimates are for $100 to 200 BILLION dollars in damage.
  
  – Expect higher prices for steel, roofing products, concrete, insulation, drywall & copper as a result of heavy consumption during the rebuilding process, stockpiling of materials, and damage to manufacturing facilities. For example Air Products & Chemicals facilities sustained substantial damage. They are the primary supplier of liquid hydrogen, a critical component in the steel production processes, to the steel industry.
• Labor prices could also rise since workers will be enticed to the storm ravaged area by the lure of higher wages, and all the overtime they can work. Ergo KSC could be affected by labor and material shortages, which will transform into increased costs. The repercussions will not be a brief spike, but a plateau that will ramp up rapidly and should begin tapering off sometime in 2007.
• The Exploration Program is gearing up; studies and designs for a massive construction program are beginning. Early indications are for two major construction phases, the first will be for the Crew Exploration Vehicle (CEV) & Cargo Launch Vehicle (CLV) which are tentatively slated for inaugural launch in 2011, the second is for the Shuttle Derived Inline Heavy (SDIL)
• If the CEV program is to meet the initial schedule $500 Million to $1 Billion in construction contracts will be awarded, and completed between 2007 & 2010
• After the last shuttle flight currently slated for 2010 the second phase will be work for the SDIL will continue until 2015. The exploration construction expenditures are expected to augment the existing “normal” construction efforts, not replace them, which when added to the exploration construction program equates to $2 Billion dollars in KSC construction of facilities (CoF) work between 2006 and 2020.
• Substantial additional expenditures will be required for research and development (R&D) functions that will be required to activate the facilities, and the fabrication of ground support equipment (GSE) which should add an additional $1 to $2 Billion into the local economy.
• Now that you have been burdened with a fragment of the details, there are many more factors that will affect this dynamic situation, like the cooling housing market, rising interest rates, oil prices, future hurricanes, terrorist activities, other large construction projects in the area, potential of more restrictive building codes, etc.
• You should be wondering how your KSC projects will be impacted. There is a simple answer to this complex economic question, but near term, generally expect to see an initial cost spike, primarily as a result of material prices
• Keep in mind costs could be substantially higher on some projects, like roof replacements
• Far term, when exploration projects are initiated, more substantial increases are anticipated
• This will be primarily a result of saturation of the local contracting firms, yes of course this will attract some large firms to KSC, but they typically hire many local contractors, they also tend to absorb the local trade workers. This will result in a requirement to recruit “critical trades” from outside of the immediate area. When contracting firms are overwhelmed with work costs increase primarily, for two reasons lack of competition, and cost to recruit & entice them to travel to the area. Once there housing must be obtained, often in competition with tourist’s who can afford substantially higher rates. Significant overtime may be required to maintain already tight schedule, which will also affect project costs
Inflation Rate Triples Last Year’s Pace

- According to ENR Magazine:
  - “Preliminary data indicate that inflation has not yet peaked, with several indexes already breaching the double-digit barrier. ENR’s Building Cost Index rose from a 9.0% annual rate in July to 10.4%”

<table>
<thead>
<tr>
<th>Builder's Construction Cost Indexes</th>
<th>Name, Area and Type</th>
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<th>Change Year (%)</th>
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<tr>
<td>General Purpose Cost Indexes</td>
<td>ENR 20-city: Construction Cost(^1)</td>
<td>623.33</td>
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<td></td>
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<td>545.24</td>
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<td></td>
<td>Commerce Dept.: Fixed weighted(^7)</td>
<td>129.50</td>
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<td>Commerce Dept.: Price Deflator(^7)</td>
<td>130.20</td>
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<td></td>
<td>BuRec: General Building(^2)</td>
<td>243.00</td>
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<td></td>
<td>Factory Mutual: Industrial(^3)</td>
<td>198.00</td>
<td>11.1</td>
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<td>Handy-Whitman: General Building(^4)</td>
<td>331.50</td>
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<td>Lee Saylor Inc: Material Labor(^4)</td>
<td>619.61</td>
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<td>Means: Construction Cost(^5)</td>
<td>132.00</td>
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<td>Selling Price Indexes-Building</td>
<td>The Austin Co: Industrial</td>
<td>516.85</td>
<td>9.6</td>
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<tr>
<td>M&amp;S Boechkh Valuation Indexes</td>
<td>Marshall &amp; Swift: Industrial(^1)</td>
<td>133.80</td>
<td>10.2</td>
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</table>

\(^1\)Base: 1967=100, \(^2\)Base: 1977=100; \(^3\)Base: 1980=100; \(^4\)Reinforced building concrete six region average; \(^5\)Base: 1993=100; \(^6\)Base: 1958=100; \(^7\)Base: 1992=100; \(^8\)Base: April 2001=100
Cost Escalation and Labor Productivity Survey

- What can we do about it?

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<td>1. Education of the Consumers, Unions and Students</td>
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<td>108</td>
<td>61</td>
<td>48/ST271**</td>
<td>14</td>
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<td>65/ST252</td>
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<td>3. Political Activity for Legislative Action-Right to Work, Regional Bargaining, Common Expiration of Labor Contracts, etc.</td>
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<td>22/ST219</td>
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<td>5. Owner Education as started by Anti-Inflation Roundtable</td>
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<td>2</td>
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<td>6. Upgrading Building Codes</td>
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<td>6</td>
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<td>7. Industrial Consolidation*</td>
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<td>78</td>
<td>26</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>120</td>
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<td>(All Contracting Companies joining to make one Unified Body for Negotiation, etc. (Not AGC, ABC, NCA, etc.)</td>
<td>0</td>
<td>78</td>
<td>26</td>
<td>9</td>
<td>3</td>
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<td>Totals</td>
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<td>195</td>
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<td>102</td>
<td>1357</td>
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* Added during discussion at Montreal presentation
** Highest total votes to date

Reference JAB Volume III – Page 21
Chart #6 Cost Index Comparison

Cost Index Comparison - ENR CCI, ENR BCI, KSC, and Consumer Price Indices (By NASA Program Analysis)

ENR, CCI, BCI, KSC cost index & CPU shows escalation 1974 with projection to 2016 wit noted economical, political, weather milestones
1974-2020 using JAB computerized excel cost escalation program. $2000 - $17,000 -- worst case scenario to $22,500
• **Oct. 2, 2006** - E mail alert update a recent REED (RS Means) report shows facility construction costs up an average of 10% and some materials cost up 12% to 24% (Remember our cost alert of 4/1/04 and update months before other report of pending cost escalation of 6/10% per year. This REED report confirms our early projection.
• **Nov. 1, 2006** - Good News - Florida Today - State Approves Lower Workman’s Compensation Rate (lower by nearly 16% (15.7%) to save employers 400 million
• **Nov. 11, 2006** - A mild hurricane season for 2006 should offer some relief to our current escalation problem.
• **Dec. 1, 2006** - Christmas report, possible answers to cost escalation and U.S. economy problems. When high construction cost escalation should start stabilizing.
• **Dec. 2, 2006** - How long will high construction cost escalation last?
  – 1. Until US dollar goes up 30% (to par)
  – 2. Until US recession/major depression in housing market
  – 3. Until successful use of Helium 3 as a US electrical power source. This may take several years.
  – 4. Until Successful Solar Power Generation from Space, may take 2-10 years
2006 PUBLIC WORKS OFFICERS INSTITUTE

Construction Costs Going Through the Roof?

CONTROLLING COSTS IN A VOLATILE MARKET

March 1, 2006
China in 2005

- **China Consumed:**
  - 1/2 of the world’s Cement
  - 1/3 of the world’s Steel
  - 1/4 of the world’s Copper
  - 1/5 of the world’s Aluminum
  - 1/10 of the world’s Oil
    - 10 million barrels/day
China 2006 and the Future

• No let-up in site as appetite for materials grows
• Building 11 MORE new cities the size of Houston
  – With +1.2 million km of roads, railroads, & Infrastructure
• $20+ billion plan for 2008 Olympic Construction
• Undisclosed billion $ plan for 2010 World’s Fair
• Labor force will continue to grow thru 2011
• China’s GDP growing at 10% per year
• By 2040 China’s GDP to be greater than U.S.
Costs Forecasted in 2006

- Concrete over $100/cubic yard (up 88%)
- Rebar over $1000/ton (up 127%)
- Insurance costs 2.0 to 3.0% (up 230%)
- Scrap steel $370.00/ton (up 280%)
- Building Steel could exceed $800/ton (up 127%)
- Copper could hit $2.35/lb (up 235%)
- Diesel now at $2.48/gallon (up 91%)
- Natural gas now 9.30/mcf (up 107%)
Which Delivery system offers Best Value vs Current Usage

![Bar Chart]

Other = Lease/Lease Back, Turn-Key, CM/GC, etc.
Add Contingency & Escalation

• Contingency %’s vary with the state of the drawings
  – Design Contingency usually is carried early on
  – Construction Contingency typically starts at 10% - 15%
    reduces to 3 to 5% as the drawings are completed
  – Material Cost Contingency at 5% to 10% for cost spikes
  – Soft Cost Contingency 1 to 3%

• Choose your index % wisely. They can be confusing!
• Be sure to know how an index is determined so that
  you pick the one that is applicable to your project
• Escalation is based on a cost index trend and typically
  extends until mid-point of construction.
Construction Cost Indexes

• For 25 years cost escalation was predictable at 3 to 4%
• Suddenly in 2004 costs spiked 30% & 10 - 20% in 2005
• Construction diverged dramatically from the consistent Producer Price Index (PPI)
• Many key categories have spiked in double digits
• Many leading economists agree that there is no longer a unified indicator to predict future construction costs
• Indexes are accurate for industries that manufacture widgets not for the diverse construction industry
• Indexes are often too generic
Popular Construction Cost Indexes

- ENR Lee Saylor
- R. S. Means Marshall & Swift
- Smith Group Turner
- US Dept. of Commerce Fru-Con Corp
- Factory Mutual Eng. Handy Whitman
- Rider Hunt Levett & Bailey E. H. Boeckh
- Bureau of Reclamation C. W. Driver
BIM - Building Information Modeling

- Modeling with 3-Dimensional Plans
- Visualize with Virtual Reality Navigation
- Virtual Building approach can save you $
- Mistakes in planning can be seen instantly
- Model can link to the estimate & schedule
- Design changes automatically adjust them
- Try alternate glass systems, change plaster skin to brick veneer and the costs change
- Helps dramatically reduce inefficiencies and risk throughout the building process
BIM – 5D+ Modeling
The More Bids the Better

- Sub costs make-up around 70 to 85% of a bid
- Longer bid periods typically means more bids
- Anticipated cost deviation from budget if:
  - 1 bid in a trade +15 to +40%
  - 2-3 bids + 8 to +12%
  - 4-5 bids - 4 to + 4%
  - 6-7 bids - 7 to - 5%
  - 8 or more bids - 12 to - 8%

Per Saylor Publications
What’s Being Done Globally?

• Increased global material production
  – 40% increase in steel production
  – 35% increase in cement production

• U.S Tariffs lifted on:
  – Mexican cement (reduced from $26 to $3/ton)
  – Canadian lumber (reduced to 10.8%/bf)
  – Imported Steel
Forecasts

• Cost escalation increased at +/-1% per month so far in 2006 (anticipate a +/-10% bldg increase in 2006)
• Steel prices will stabilize in early 2006 but expect long waits to get mill-order steel & spikes mid-year
• Education construction market robust through 2009
• Copper will remain unpredictable thru 2006
• Labor shortages will continue thru 2008
• China’s steel consumption not to peak until 2010
• Cost volatility to remain for the next 4 - 5 years
• Costs not likely to return to 2003 levels ever!
NEWEST AND MOST EXCITING AND IMPORTANT OF THE 300 COST ENGINEERING TOOLS

1. Over 300 KSC Cost Indexes provide experience and back up, early cost alert for construction and GSE Cost Escalation, latest dated December 30, 2006 (one of the most important tools)
2. JAB Sem. 9, Vol. 21, “Government Contractor & Computer Est. for A&E”
3. Near 500 systems summaries, facilities, GSE, processing, pads, over fifty different type of projects
4. 21 Computer Templates, Budgets, Design, Preliminary and Detailed Estimates, etc.
6. Estimating Fiber Optics Cable Method, fast and easy
7. Remote Automated Panels, Man-hours, Method, fast and easy, $10,000-$300,000
8. Cost per component, fast and easy, $1,000-$2,500
9. Fine tuning, number of bidders concept, bid strategy
10. Construction Management Analysis Method
11. Cost Index Analysis Matrix for design, productivity, etc.
12. Cost Escalation Alert Analysis, four new technical papers
13. Launch Pad Cost Comparisons, $20 million to $300 million dollars
14. Detailed Launch Pad Cost Breakdown, $1.2 billion dollars
15. VAB Cost Studies, $160 million to $2 billion dollars
16. “Accurate Estimates in a Minute”, by NASA/KSC Glenn Butts (one of the newest, most important tools)
17. Searchable CD-ROM by Dallas Lee/SGS
18. Abstract of Bids, Cost Summaries, System Summaries, hyperlinked
20. Searchable CD-ROM’s of System Summaries with Excel Search
21. Near 30 Special, Unique Cost Studies, CO, , COC, Mark-Ups, O, H& P, etc.
22. JAB PowerPoint, “How to Make System Summaries”
23. JAB PowerPoint, “Aerospace Cost Factors”, 9 different seminars lasting from 3-40 hours, 49 successful seminars
24. DVD on “Bidding Strategy” on Aerospace and Construction
25. New CD-ROM’s, #18, 19, 20, 21, and #25
26. “Space Power for an Expanded Vision” by W.M. Braselton, 15 minute video, DVD soon
27. New Multi page system summary/cost model of the $150 million dollar VAB
29. 475 Projects, Cost Estimates, over 45,000 pages (microfilm)
30. JAB Seminar #9, Bidding Process and Cost Engineering, Vol. 20
32. Estimate Confidence Levels & Constellation Confidence Summary, Glenn Butts 4/18/07
Seminar 6 Workbook

Aerospace Futuristic Cost Estimating

Aerospace Pre-Conceptual Futuristic Facility & GSE Cost Estimating:
Cost Modeling for Next Generation Launch Technology to ISS
and the Moon
For
Engineers, Contractors, Estimators, Educators, Aerospace Managers

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Lobiddervideo@cfl.rr.com
List Price: Color $400; B/W $200
## Excel Application Search / Filtering Process

### Table Example

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### Filter Example

- **AutoFilter**
- **Show All**
- **Advanced Filter...**
Construction Estimating, Bid Strategy, Cost Engineering

20 Projects

Processing Fac

Structural Steel

Launch Pad

University Dorm

High School

"JAB's Aerospace Government, & Contractors Estimating"
By Con$truction Co$t Con$ultant Inc.

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Retail Office, Warehouse
Space Congress - Cost Escalation, Tools, Facilities and GSE for Moon & Mars Program

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April 7, 2007

Seminar IV
Volume V
List Price $140.00

Assembly Building
How to Make Conceptual GSE Estimates

1. Identify Problem Or Need for GSE
   - Determine Purpose of GSE
   - Determine Requirements
   - Develop Cost Estimate

Assemble Team with The Appropriate Knowledge and/or Disciplines for Project

May include the some or all of the following:
- Project Engineers
- System Engineers
- Architectural Engineers
- Structural Engineers
- Mechanical Engineers
- Electrical Engineers
- Interfacing Systems Engineers
- Cost Engineer

Review the “20 Important Considerations for GSE Cost Estimating”

Submit For Independent Review and Approval

Type of Cost Estimate Developed
1. Base on Previous Buys, Design, Fabrication, Assembly Bid, Adjusting for Design, Escalation, and/or Location
2. Conceptual Computer Model Design
3. Combination of #1 & #2
4. Swag it – Scientific Wild ‘A’ Guess
5. Other

Note:
Add to Cost Estimate for Testing (LETF Quote), Mark-ups, FPC, Support Contractor, Contingencies, Escalation, Design Activation, etc.
Planned Polycrystalline Facility Site North of VAB Oxygen, Hydrogen, Nitrogen, Electrical Power Study Nov. ’83 QROME $151 Mil, Escalated to April 2012 $457 Mil by JAB/CCCI/Computer Prog
### System Summary of Detailed Combined Fund Estimate

<table>
<thead>
<tr>
<th>DIV. TITLE</th>
<th>Q'TY</th>
<th>UNIT</th>
<th>$Q'TY</th>
<th>$SSB</th>
<th>TOTAL</th>
<th>DIV. TITLE</th>
<th>Q'TY</th>
<th>UNIT</th>
<th>$Q'TY</th>
<th>$SSB</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>1. GRL. COND.</td>
<td>1,756,905</td>
<td>BSF</td>
<td>9.42</td>
<td>-</td>
<td>-</td>
<td>2. SITE WORK</td>
<td>26.73</td>
<td></td>
<td>9,901,608</td>
<td>328,673</td>
<td>9,901,931</td>
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<tr>
<td>2. SPECIALTIES</td>
<td>1,280,980</td>
<td>BSF</td>
<td>0.72</td>
<td>-</td>
<td>-</td>
<td>4. CONCRETE PANELS</td>
<td>50,580</td>
<td>SF</td>
<td>16.09</td>
<td>522,553</td>
<td>522,553</td>
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<tr>
<td>3. MACHINRY</td>
<td>0.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. WOOD/PLASTICS</td>
<td>0.24</td>
<td>lb</td>
<td>45.063</td>
<td>45.063</td>
<td>45.063</td>
</tr>
<tr>
<td>4. DESIGN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C. DOORS &amp; GLASS</td>
<td>9.73</td>
<td></td>
<td>1,846,561</td>
<td>1,846,561</td>
<td>1,846,561</td>
</tr>
<tr>
<td>5. F.S. FEES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D. UTILITIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. 90,000 SF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E. LAND ITEMS</td>
<td></td>
<td></td>
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</tbody>
</table>

**SUMMARY**

- **Total Construction Costs:** $9,901,931
- **Total Design Costs:** $45.063
- **Total F.S. Fees:** $1,846,561
- **Total Utilities:** $0
- **Total Land Items:** $0

**Additional Notes:**

- Item 2.2.2.6 includes 2400 sf of brick masonry.
- Item 3.3.6 includes 500 sf of glass block.
- Item 4.4.1 includes 1500 sf of metal roofing.
- Item 5.5.1 includes 1000 sf of brick veneer.

**System Design:**

- **Total Design Features:** 10,000 sf of masonry, 5000 sf of glass block, 1500 sf of metal roofing.

**System Utilization:**

- **Total System Utilization:** 2400 sf of brick masonry, 500 sf of glass block, 1500 sf of metal roofing.
Installed Fiber Optic Cable Costs – New Exciting Estimating Tool

- **Average Cost Summary Chart – [per fiber meter (FM) and per fiber foot (FF)]**

<table>
<thead>
<tr>
<th>SIZE OF PROJECT</th>
<th>FM AVERAGE COST</th>
<th>BY FIBER METER (/fm)</th>
<th>BY FIBER FOOT (/ff)</th>
<th>FF AVG. COST</th>
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</thead>
<tbody>
<tr>
<td>Small</td>
<td>0.96</td>
<td>.72 - $1.53</td>
<td>.30 - .45</td>
<td>0.34</td>
</tr>
<tr>
<td>Medium</td>
<td>0.67</td>
<td>.61 - .72</td>
<td>.19 - .22</td>
<td>0.205</td>
</tr>
<tr>
<td>Large</td>
<td>0.46</td>
<td>.36 - .47</td>
<td>.11 - .15.5</td>
<td>0.13</td>
</tr>
</tbody>
</table>

- **Overall Average = .688 / fm – (.17 / ff)**
  - Small size projects – Less than 600,000 fiber meters
  - Medium size projects – 600,000 to 1.5 million fiber meters
  - Large size projects – over 1.5 million fiber meters
Sample Panels - Cost per Component Fast & Easy
Color Graphics MS PowerPoint TM Presentation
Educational Estimating Study Tools

- Ocean launch picture
- Cost Reductions:
  - No Down Range Tracking Facilities needed, can be tracked by satellite.
  - Reduced government paperwork, rules, policies
  - Time saving - reduced downtime for other launches
  - Reduced personnel for operations and launching
  - Reduced air traffic for remote ocean launch platform
• Cost Factors for Facilities, GSE and O&M 2/15/2002 JAB/G. Hajdaj. (Ref #34)

Ship and Shoot Concept using liquid propellants
- No need for Acid Protection

Reduced Cost – Clean Pad Concept:
- No Towers needed
- No Pad Clean Rooms needed
- No Sound Suppression System
- No Lightning Protection needed
- No GN2 Explosion Proof Components needed
- No Protective Coating & Painting needed
- No Extra Weather Protection needed
- No Cranes needed

Example – Launch Pad Costs:
- 1996 Florida Spaceport Launch Pad $6 M
- 1997 California Space Port Launch Pad $20 M
- 1998 Kodiak Alaska Launch Pad $40 M
- 1967-1985 Apollo / Shuttle Launch Pad $121 M – ROM $2 Billion Budget
- 2003 EELV (Each Pad 37/41) $300 M (Each Pad)
• A tool to project cost data is a computerized cost escalation program that escalates all KSC cost data since year 1974 to year 2012
• Simple 4-step or 18-step program for lump sum projects, for multi-billion dollar projects or unit prices
• Cost can be fine-tuned using the Analysis Matrix Estimating Tool
• See Escalation Chart

**EXCEL ESCALATION CHART FOR PROJECTS 1974 - 2012**
**BASED ON JAB KSC COST INDEX - TOTAL LABOR & MATERIAL**

**PROJECT NAME: KSC VAB/LC-39**
**DATE: 04-12-2002**

Enter …
Month and year of known project
(must be date between 1/74 and present)
Cost of known project (did cost)
Month and year of new project
(must be date between 1/74 and 12/2012)

Then …
Index for known project = 4797
Index for new project * = 6957
Index ratio new/known = 1.4503

Projected cost of new project (will cost) =
Cost of known project x ratio =

**$ 774,369,491**

**ECBC**

**OTHER**

**NOTES**
All escalation factors from October 2001 to Dec 2012 are based on 4% per year estimated escalation.
Use unit price chart (next sheet) for square foot and cubic foot unit prices.
Enter date formats as first three letters of month and last two digits of year.
For dates beyond 2000, enter date format with all four digits of year.
If chart does not work, check data table to see if the month entered is available.
If month is not available, use closest available month.
* Check index backup data.

See Refs #28 & 35, Past, Present, and Future Aerospace Computer Programs for escalation 1974-2012
This program developed and documented by Gene Hajdaj and Joe Brown

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April 7, 2007
New Concrete Office Bldg 30000 SF

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<th>E</th>
<th>C</th>
<th>C</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Average</td>
<td>$169</td>
<td>$190</td>
<td>$244</td>
<td></td>
</tr>
<tr>
<td>Today's ECCP</td>
<td>$169</td>
<td>$190</td>
<td>$244</td>
<td></td>
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</table>

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<tr>
<th></th>
<th>C</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td>Average</td>
<td>$216</td>
<td>$242</td>
<td>$311</td>
</tr>
<tr>
<td>Escalated CCE</td>
<td>$216</td>
<td>$242</td>
<td>$311</td>
</tr>
</tbody>
</table>

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<tr>
<th></th>
<th>E</th>
<th>C</th>
<th>C</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>$5,335,200</td>
<td>$5,986,000</td>
<td>$7,689,300</td>
<td></td>
</tr>
<tr>
<td>Escalated ECCP</td>
<td>$5,335,200</td>
<td>$5,986,000</td>
<td>$7,689,300</td>
<td></td>
</tr>
</tbody>
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<table>
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<th></th>
<th>C</th>
<th>C</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>$6,482,200</td>
<td>$7,273,000</td>
<td>$9,342,500</td>
</tr>
<tr>
<td>Escalated CCE</td>
<td>$6,482,200</td>
<td>$7,273,000</td>
<td>$9,342,500</td>
</tr>
</tbody>
</table>

Test by Glen Butts and Dallas Lee

![Today's ECCP Cost By CSI Division](chart)

<table>
<thead>
<tr>
<th># of Stories</th>
<th>1</th>
<th>Number of Bidders</th>
<th>4</th>
<th>CCE Including Design (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Development</td>
<td>Average</td>
<td>Project Bid Date</td>
<td>Sep-06</td>
<td>Average</td>
</tr>
<tr>
<td>Finish</td>
<td>Average</td>
<td>Project Location</td>
<td>KSC</td>
<td>Avg + SD</td>
</tr>
<tr>
<td>Engineering</td>
<td>Average</td>
<td>Lead Level</td>
<td>None</td>
<td>Maximum</td>
</tr>
<tr>
<td>Estimate #</td>
<td>40.0046</td>
<td>Difficulty</td>
<td>Normal</td>
<td>Median</td>
</tr>
</tbody>
</table>

Estimates are based on historical projects, and exclude activation costs which can be substantial.


Test by Glen Butts and Dallas Lee
WHAT IS PRESENTLY BEING DONE TO KEEP ESCALATION DOWN?

• Increased productivity, examples:
  – computerization,
  – electronic energy,
  – efficiency

• CPI consistency under estimates, cost increases to keep social security, labor, pension down
  – medical, property taxes, insurance, homeowners, etc
Now the surprising, confidential, sensitive background –

How did the author project the cost escalation alert months before the usual daily and weekly reports?

- The surprise was a valuable use of the London Financial Times Daily with independent, global commodities, currency and construction reports of increasing demand and lack of increasing supplies, especially China and Indian growth.

- The sharing of Cost Data between USA, NASA, KSC Support Contractors, vendors and suppliers and bidding problems due to hurricanes, disasters, etc. The KSC Cost Index TR1511, 1974-2007 was especially valuable with labor rates and materials (240 items), productivity and workman’s compensation rates.

- The Florida Section and AACE International “Cost Escalation and Labor Productivity - What We Can Do About It” and what we did about it - meeting programs, surveys, seminars, and symposiums since 1970 and AACE local and national members reports and alerts, etc.

- Also, the over 300 education and estimating tools created, developed, tested, and documented by KSC, USA, CCCI, and JAB teamwork since 1963-2007. Therefore a special thank you to all, especially, Susan, Dallas, Mel Jones, Gene, Glenn, Steve, Mike, and Phil and our team work members. See lobidder video and bid strategy DVD “How Successful Contractors Solved High Cost Escalation Problem - Runway and Processing Fact.
E-mail from JAB April 13, 2007:  KSC INDEX SAYS “USE 8% PER YEAR TO MID POINT OF CONSTRUCTION”.  JAB COMMNTS PER INDEX “COSTS UP 9.95% FOR 2006 -- 7.53% FOR 2005 & 24.36% FOR 2004” THEREFORE CONFIRMING JAB COST ALERT OF 4/1/04.

SUMMARY

What should be used for cost escalation for the NASA KSC Space Program for Space, Moon & Mars? Consider using 5% to 10%* per year, but on major multi-year that are heavy weighted in concrete, steel, rebar, copper, asphalt & aluminum do a cost analysis, get quotes on major cost items. Remember that impact, scheduling delays will cost extra for time extensions & change orders.
(* wide variation for national and world economy, hurricanes, analysis, quotes, etc.)
A Special Thank-You to AACE, KSC, USA, A&E, CCCI and team members for your support

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JBrown13@cfl.rr.com
www.spacevisioncongress.com