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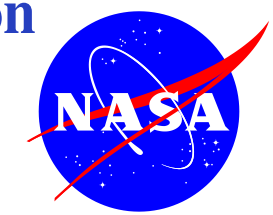

Project Integration Architecture

http://www.grc.nasa.gov/WWW/price000/index.html

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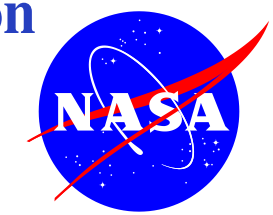

Project Integration Architecture (PIA) Oversimplified Nutshell

Project Integration Architecture (PIA) is a distributed, object-oriented, architectural framework that provides (in a machine-intelligible manner) for the generation, organization, publication, integration, and consumption of all information involved in any process.

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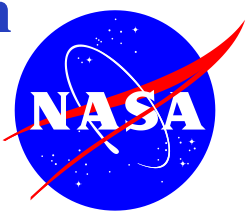

Key Object-Oriented Technologies Exploited by PIA

1. Self-revelation: Objects can reveal their kind and the extent of their content.

   1.1 Self-revelation of kind sets the expectation for the nature and content of an object.

   1.2 Self-revelation of content exposes the extent to which expectations are, in fact, fulfilled.

2. Semantic infusion through class derivation: By progressive derivation from parent to child, the nature of the derived child can be progressively defined.

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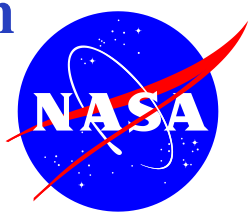

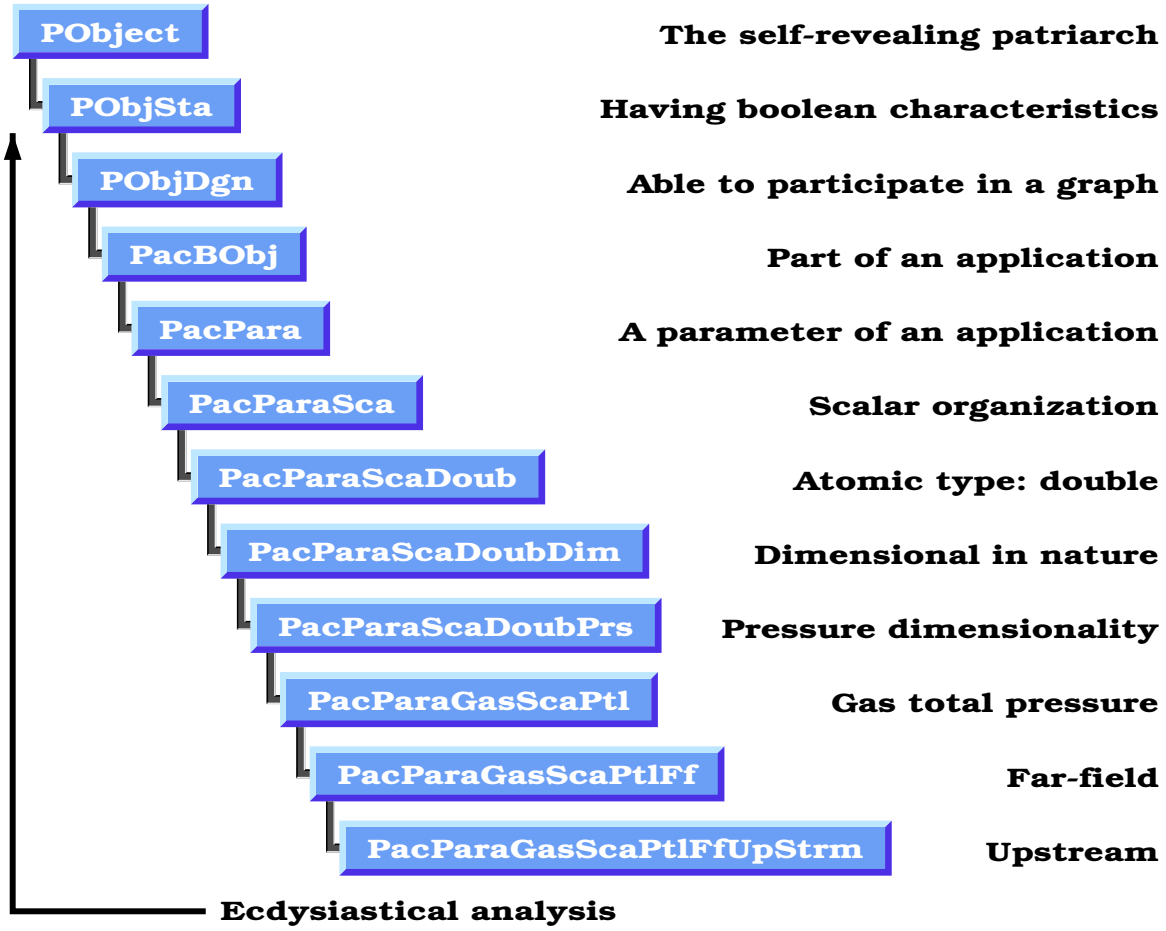

Semantic Infusion Through Class Derivation

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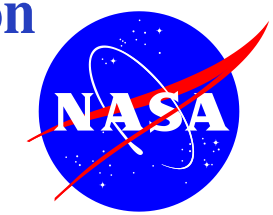
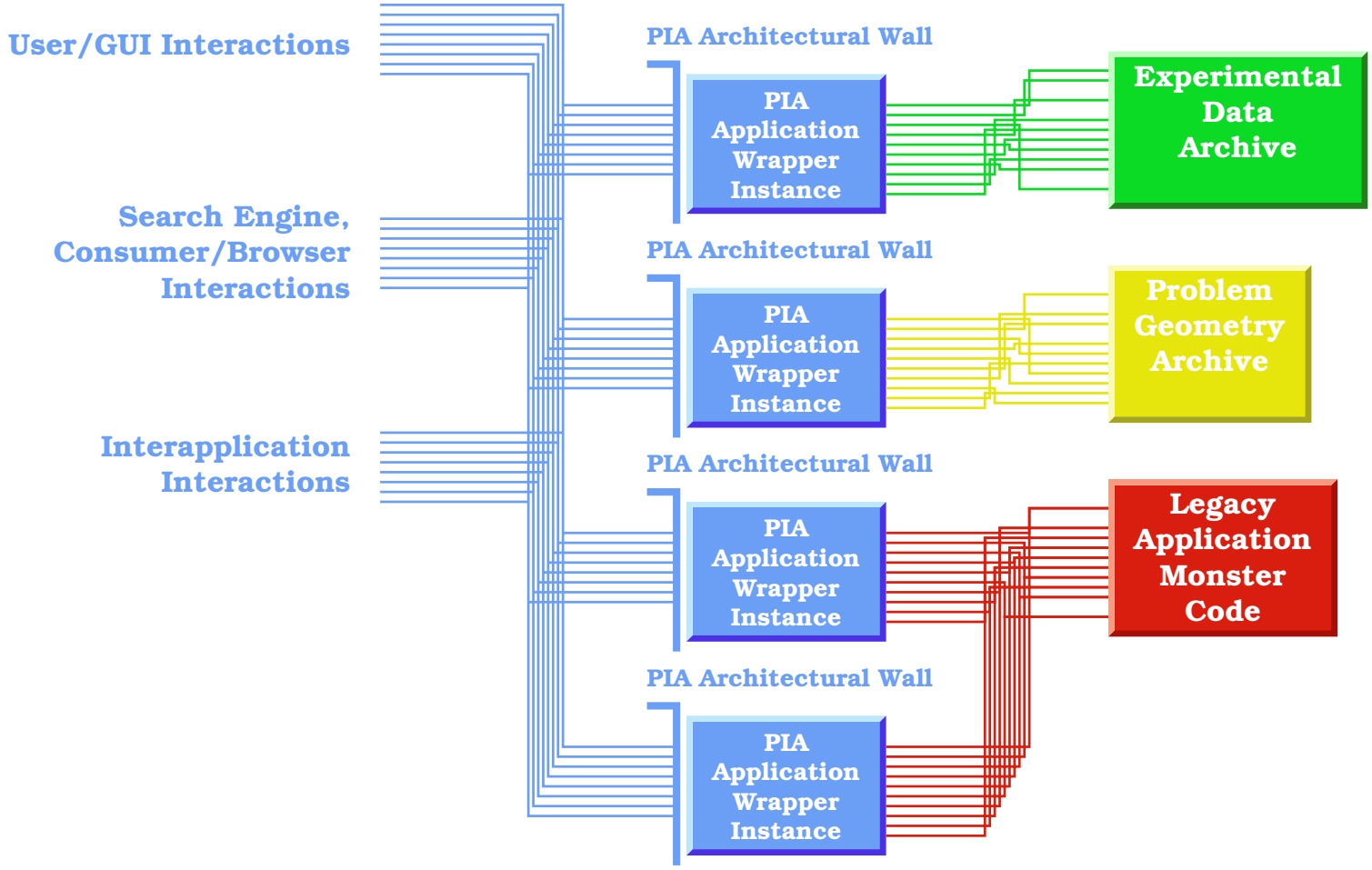
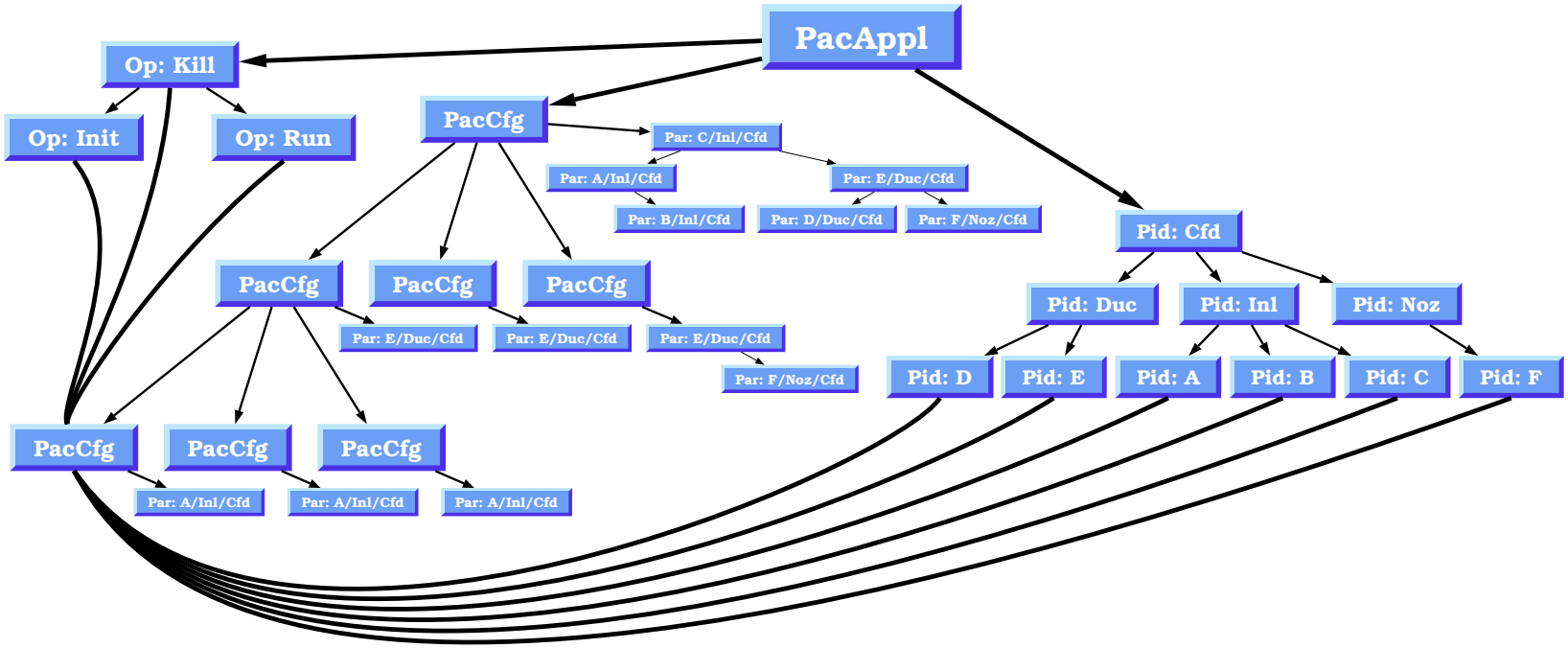




PIA Application Architectural Wall Concept



The PIA Self-Revealing Application Architecture

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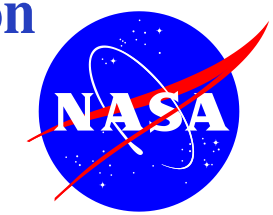

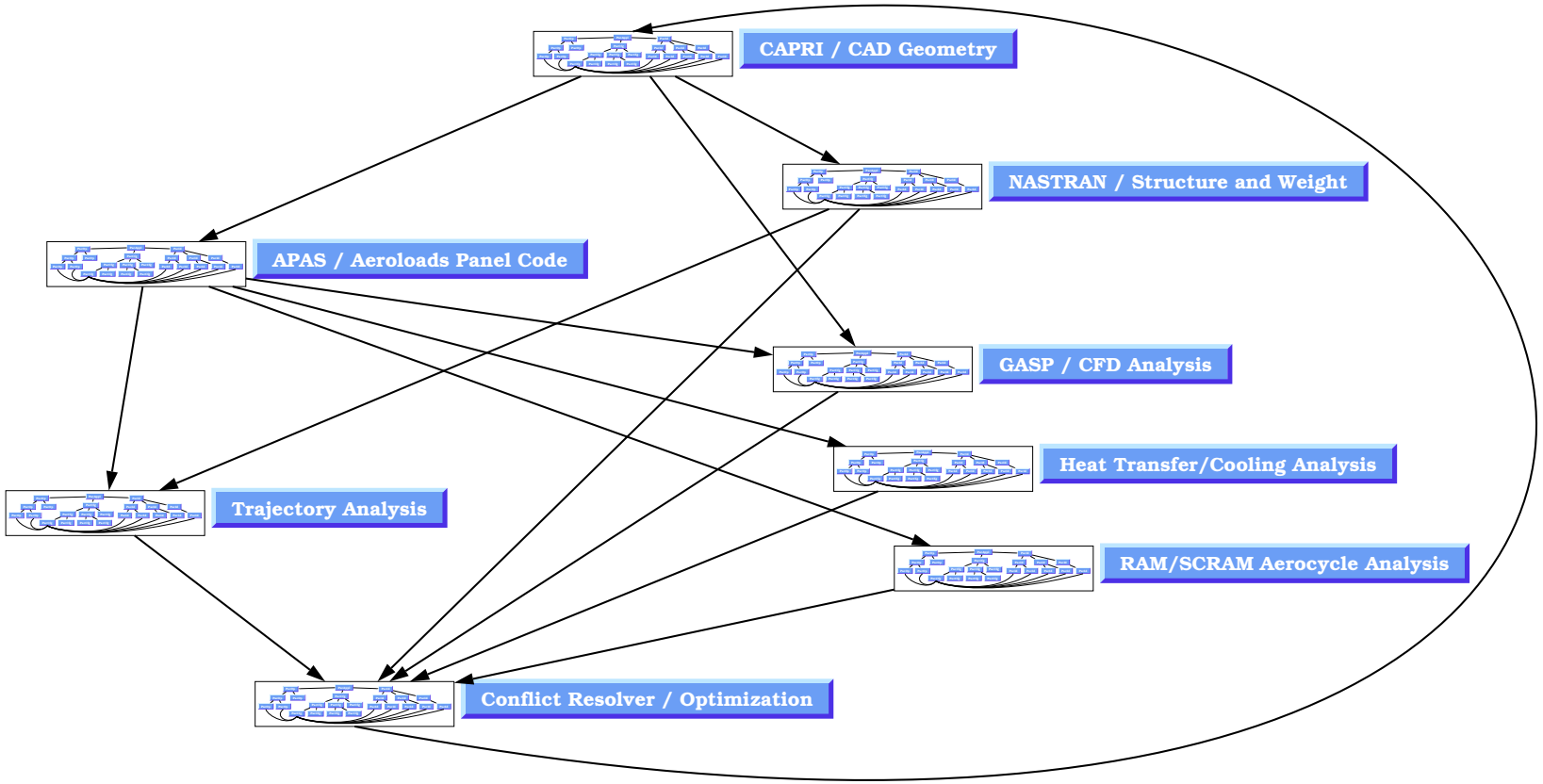

Integrated Application Graphs

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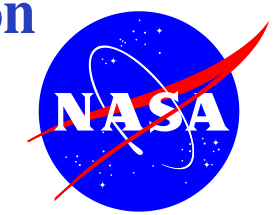

Autonomous Solution Systems

Given a sufficently rich environment, PIA provides the basis upon which application graphs may be autonomously assembled.

1. The application object can reveal the set of parameters which it produces and, upon further interrogation, the input parameters needed to generate any particular output.

2. Given a desired output, an automated process similar to a program linker can identify the application producing that parameter. The needed inputs are noted and a recursive search performed to satisfy those needs until only inputs that can be guessed at random remain.

3. The graph is completed with a final loop-back application that guesses initial inputs, runs the analysis, examines the resulting output, and trys new inputs based upon the result.

4. The graph assembly process can be made more efficient by constructing catalogs mapping produced parameters to specific applications.

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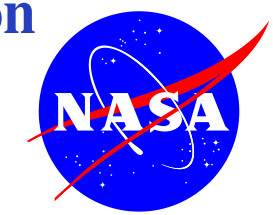

Automatic Solution System Benefits

1. Extension of application integration beyond the limits of human capability.

   1.1 With a 99.99% connection accuracy, an integration with 20,000 connections has an 86% chance of having one wrong connection.

2. Elimination of human failings from the solution formulation process.

   2.1 Accurate transfers of information.

   2.2 Dispassionate consideration of alternative strategies; one NASA, one collective.

3. Automated risk assessment of the solution process.

   3.1 Identification of weak or missing technology areas.

4. Discipline expert's team participation time reduced; time freed for discipline development.

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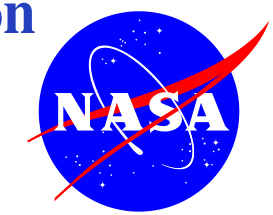

CORBA Migration Benefits

1. Allows the architecture to extend into a collective of trusted servers and server clusters.
2. Allows the extension of data spaces to terabytes, petabytes, exabytes, and beyond.
3. Allows multiple simultaneous consumers of served information.
4. Allows cross-language consumer capabilities; a Java GUI may be made to access a C++ server.
5. Allows the services of an application to be provided without the necessity of releasing the proprietary, capital-asset code to those receiving those services; software maintenance reduction.

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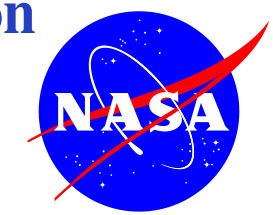

PIA Speed of Data Access

No facility dealing with an exabyte of data is likely to be characterized as being "fast"; however, PIA facilities are expected to allow expeditious access to such volumes of data.

1. PIA's primary data sorting facility is the balanced, binary tree which provides a reliable, scalable *log n* search cost for items. For example, the expected search for any one particular item in a tree of a billion billion items (an exa-item tree) is only 60 key comparisons.

2. PIA uses a deep, *n-ary* tree directory structure to organize the files holding the internal states of deactivated objects. Continuing the exa-item example, the file for any particular object would be identified, on average, after only 128 file-name comparisons.

3. Combining these two technologies is expected to allow PIA to provide reasonably rapid access to very large amounts of data. Again continuing the exa-item example, assuming that the objects of the entire tree were inactive at the time a search was begun, a particular item could be identified and its data made available after a total of only 7,680 (128 times 60) file operations.

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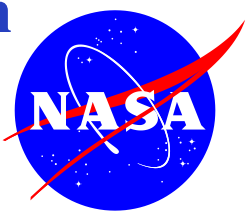

Project Status

1. Single-machine, C++ prototype demonstration of technology complete.

   1.1 Propagation of geometry information from ProEngineer to LAPIN through PIA technology demonstrated. Performance improvement from weeks to about an hour.

2. Migration of the architecture to Common Object Request Broker Architecture (CORBA) implementation in progress.

   2.1 Foundation layer classes complete and operational; Application foundation/infrastructure implemented and demonstrated; Full generic application set expected fall/winter CY03.

3. Commercialization planning begun.

   3.1 Four Software Use Agreements in place: Emergent Technologies (LIFT), Tal-Cut Company, Entara Technologies Group, C. Harnett Teska (Center for Advanced Technology and Innovation, Racine, Wisconsin).

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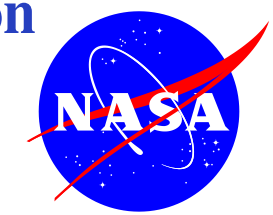

Tentative Commercialization Plan -- Core Technology

Core integration technologies to be released as open-source freeware available for download from a publically-accessible code versioning server.

1. Avoids the proprietary trap in which company assets are locked up in the vendor's confidential data format and are accessbile only through the vendor's tools.
2. Provides an expansive test/debug/redesign/augmentation community at near-zero cost to NASA.
3. Allows low-cost, boot-leg experimentation before buy-in.
   - 3.1 Geeks can download it, try it, see how it works, and then make their case to management, rather than
   - 3.2 Make their case to management, spend a bundle, get it, try it, find out it doesn't do what they thought, apologize to management, and lose their jobs.
4. Substitutes cross-corporation/agency cooperation on a shared standard for big-corporation/agency mandates for specific vendor solutions. Especially avoids the problem when two "big boys" don't agree.

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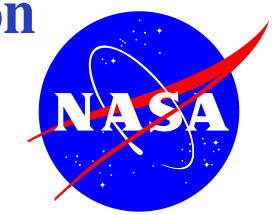

Tentative Commercialization Plan -- Revenue Streams

1. Knowledge delivery.
   - 1.1 Consulting, training.
   - 1.2 Service delivery, in the manner of Redhat, Inc.
2. Ancillary software products.
   - 2.1 Application wrapper's workbench.
   - 2.2 Discipline-specific visualizers/workbenchs.
   - 2.3 Operational suites; statistical characterization, design of experiments, optimization, six-sigma, in the manner of Engineous Software Inc., ISight.
3. Plug-and-play application products; for those who want to be private.
4. Served application collectives; direct sales of application services without shipping code to the customer.
5. Raw hardware sales; big server farms.

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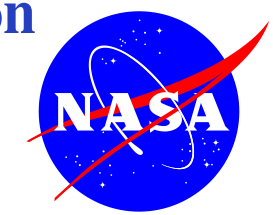

Tentative Commercialization Plan -- Unresolved Issues

1. The CORBA-served PIA application layer uses strong Rivest/Shamir/Adleman (RSA) encryption to protect password and other sensitive information exchange and storage. Additionally, omniORB V4.x foundation supports OpenSSL communications protection.

2. Export law appears to forbid the release of strong encrytpion technology.

3. Believable protection of such information is vital for commercial acceptance and success; users and providers will not hazard their valuable or sensitive resources unless a standard of protection is met. Exportable weak encryption simply does not rise to this level.

4. The RSA algorithm is well known, well understood, well implemented, and well distributed on a world-wide basis; export control provides nothing beyond the mere appearance of propriety.

5. Competent legal guidance is needed. Adjustment of export controls to reflect existing realities would be good, but is probably unlikely.

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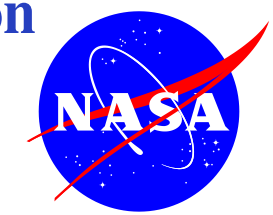

Backup Slides

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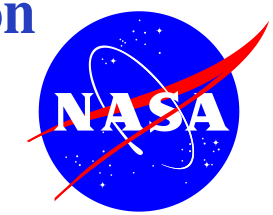

Needed list: **Found List:**
Cost/Pound

Starting the Autonomous Assembly of an Application Graph

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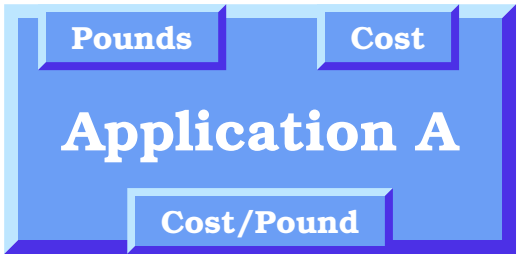

Needed list:
Cost
Pounds

Found List:
Cost/Pound

Continuing the Autonomous Assembly of an Application Graph

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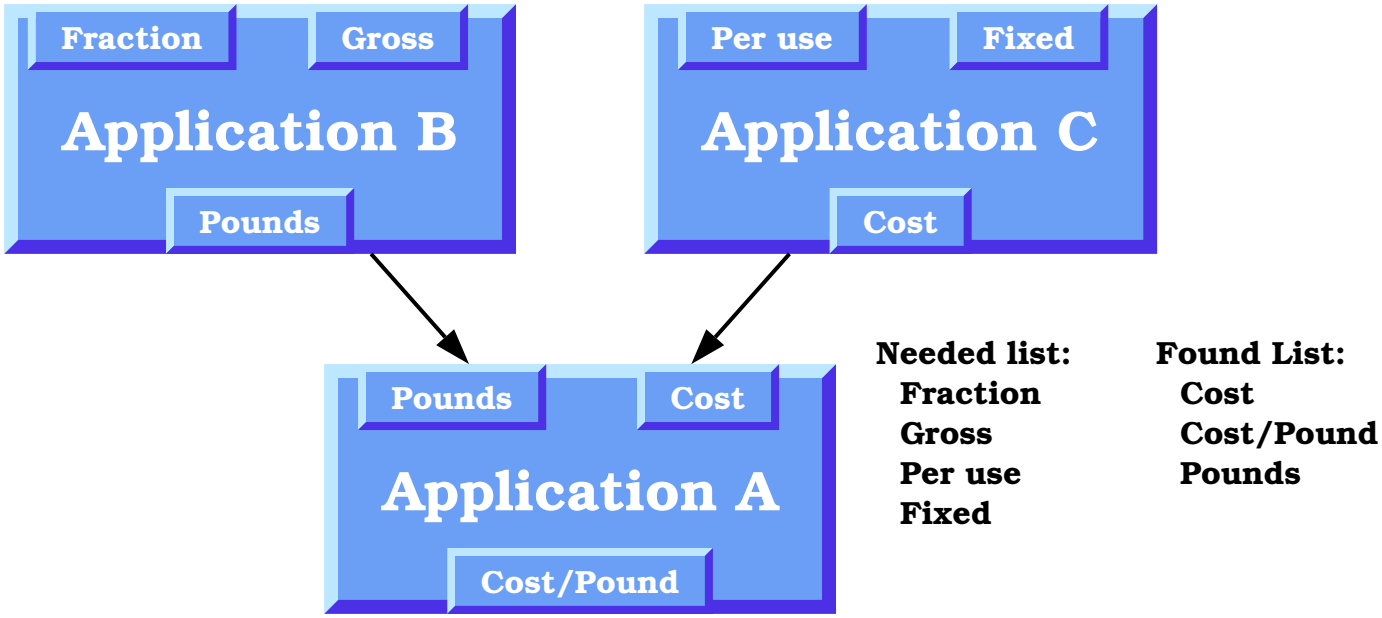

Further Recursion of the Autonomous Assembly Algorithm

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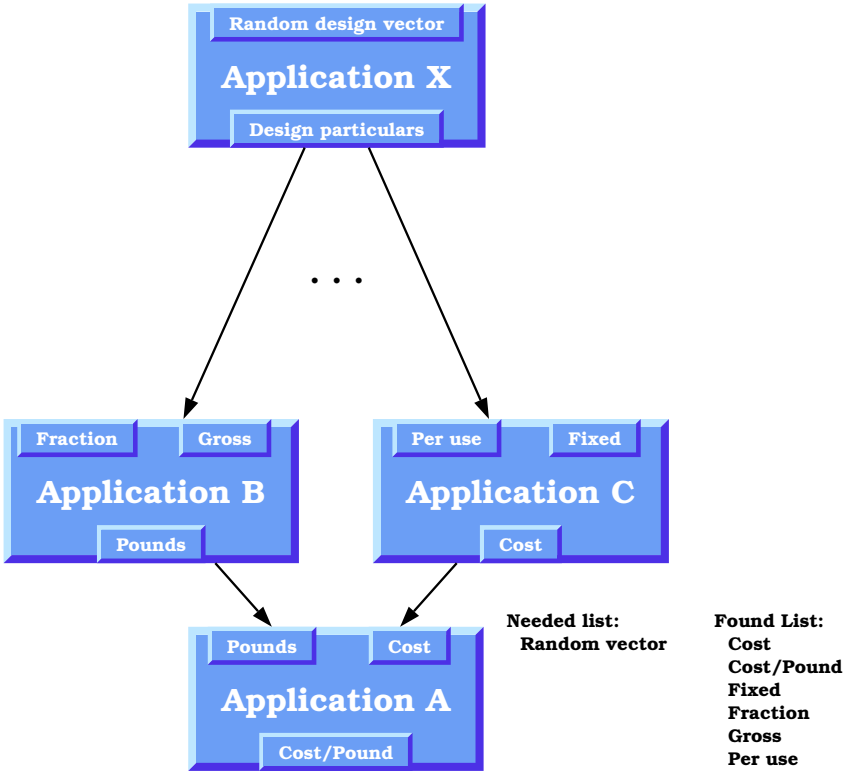

Reduction to Applications Requiring Only Random Inputs

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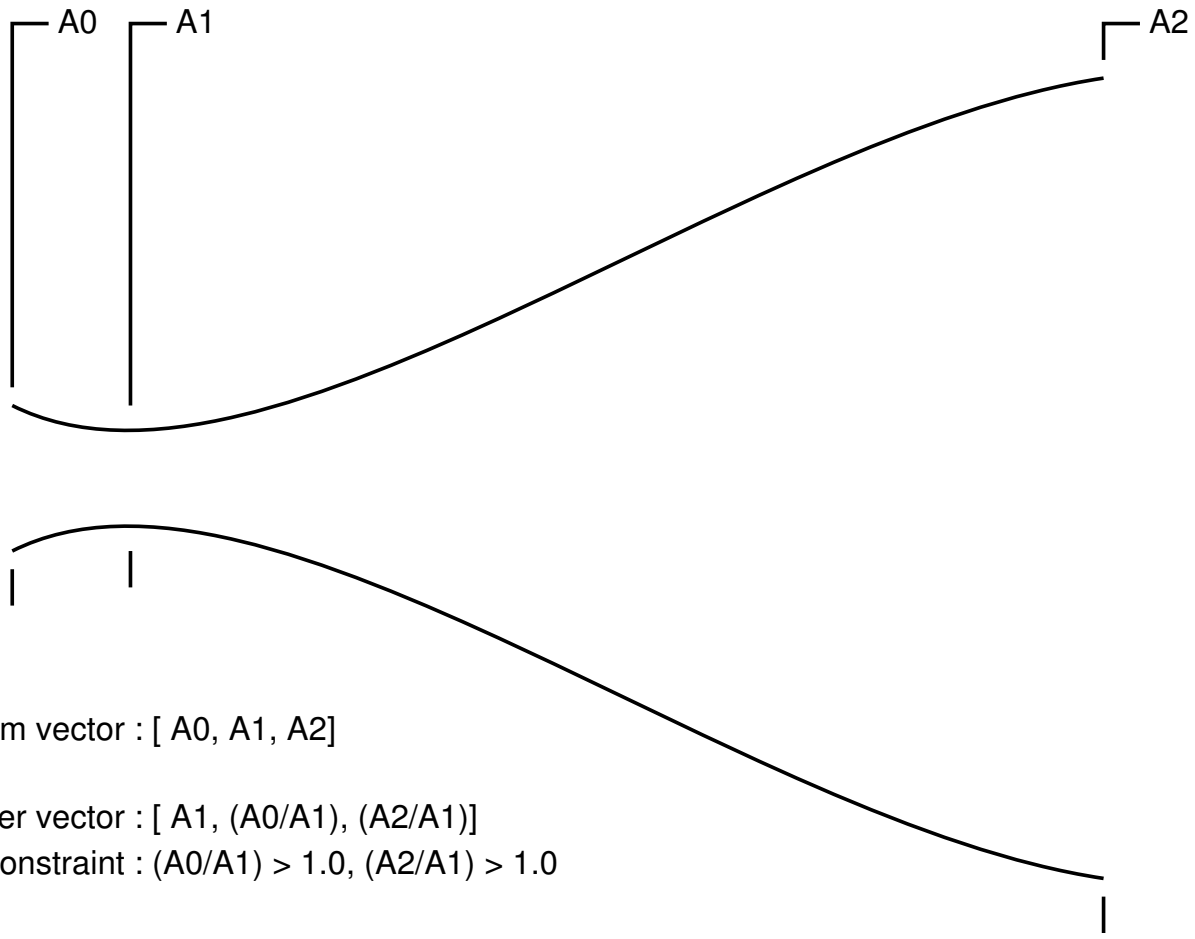
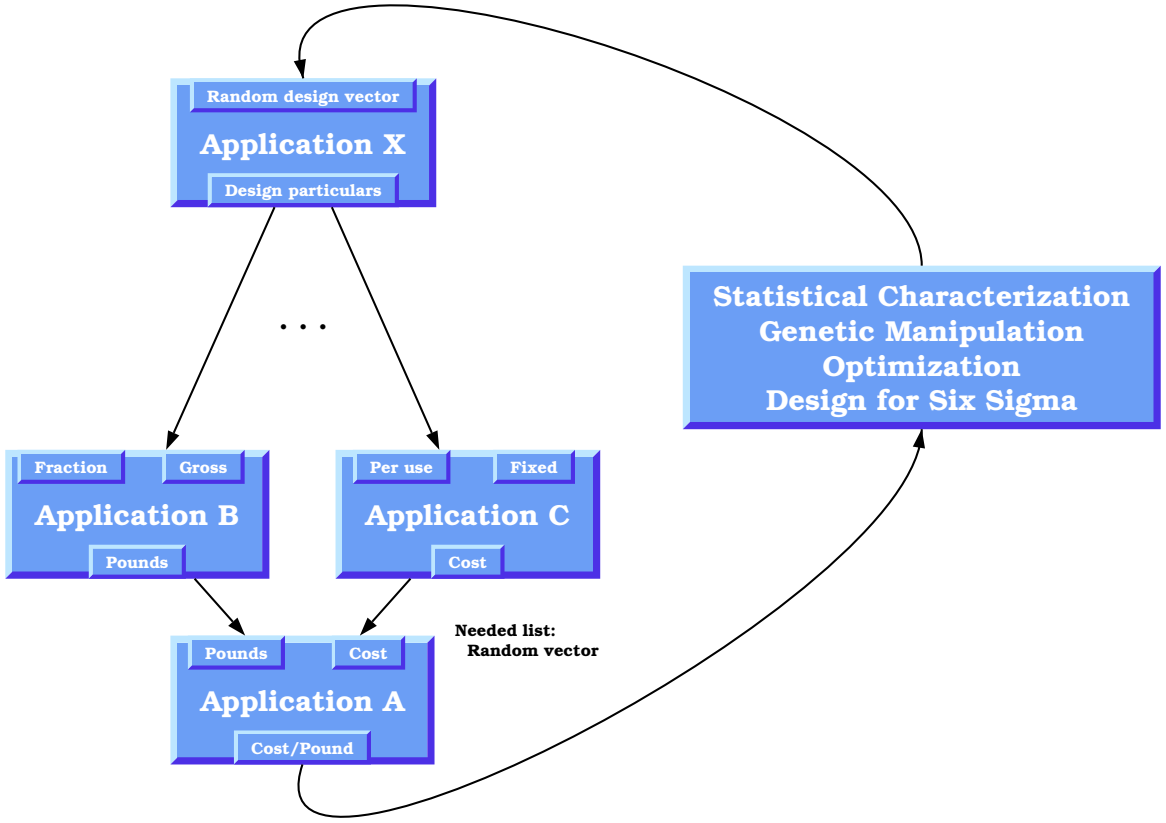


Random vector : [A0, A1, A2]

Better vector : [A1, (A0/A1), (A2/A1)]

Constraint : (A0/A1) > 1.0, (A2/A1) > 1.0

A Rocket Motor Design Application with Random Inputs



Application of Solution Initialization and Improvement Technology

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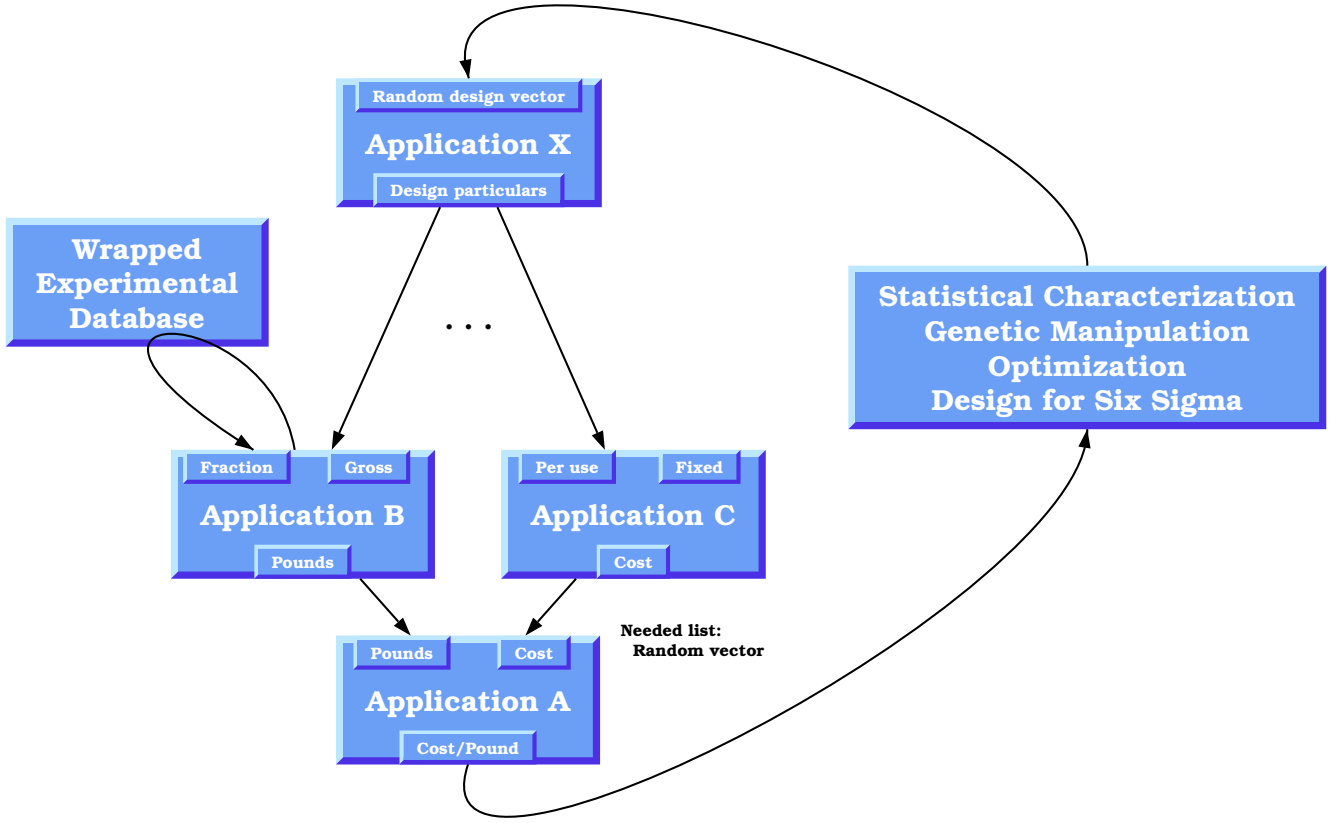

Use of Relevant Experimental (or Other) Information