

## **HOW INTEGRATED SYSTEMS WILL HELP INCREASE THE PRODUCTIVITY OF ANALYSIS**

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### **ABSTRACT**

With the cost of computing coming down, CAD/CAM is proliferating, even down to personal computers. The entry of geometry has always been the most time consuming and uninteresting part of any engineering analysis. But now the geometry is available on CAD/CAM systems. To increase the productivity of engineering analysis, industry will have to develop integrated systems with database management capabilities. Pre-/postprocessors will play a vital role in cutting down time to enter data and interpret results respectively. The bottom line is that integrated systems will surely increase the productivity of engineering analysis.

### **INTRODUCTION**

There are two schools of thought on the integration of CAD and ANALYSIS. One views this merger as the key to integrating all aspects of factory automation. The other is skeptical about the need for such sophisticated design tools and backs up this observation with the assertion that the software needed for integration is neither perfected nor affordable. Although each camp has valid points, organizations that have tied CAD to ANALYSIS may well have a competitive advantage over those companies that have not made this link.

The experience of the firms that have integrated CAD and ANALYSIS has proved that product quality and design productivity are improved.

### **TYPICAL ANALYSIS PRACTICE**

Design and analysis functions traditionally have been performed separately by different groups of engineers using individual analysis programs. Typically, designers are supported by engineers working out of an engineering support group or research and development department. Data is passed from designer to engineer in the form of drawings and specifications, with extensive discussions generally required to understand all of the geometric details of the design. The engineer runs ANALYSIS on a large main frame or a super minicomputer or on a large timeshared system. Results are interpreted by the engineer. Additional discussions are then required for the design modification.

## **ANALYSIS USING INTEGRATED SYSTEM**

One important element in an integrated system is automatic transfer of data between CAD and ANALYSIS. In such a system, both the designer and analyst share the database accessed through the same workstation or over a network. The designer still meets with the engineer to explain design functions and to interpret results. However, the main advantages are to save time and increase accuracy in entering the geometry for the ANALYSIS. Instead of looking at a drawing to determine geometric details, the engineer looks at a graphic display terminal and generates a mesh working from the existing CAD database.

## **SUBSTANTIAL AMOUNT OF SOFTWARE IS STILL REQUIRED**

To integrate CAD and ANALYSIS, a substantial amount of software development effort is still required. However, many of the packages that unite separate drafting and pre-processing programs are already working and providing productivity and accuracy improvements, and better software is rapidly being developed.

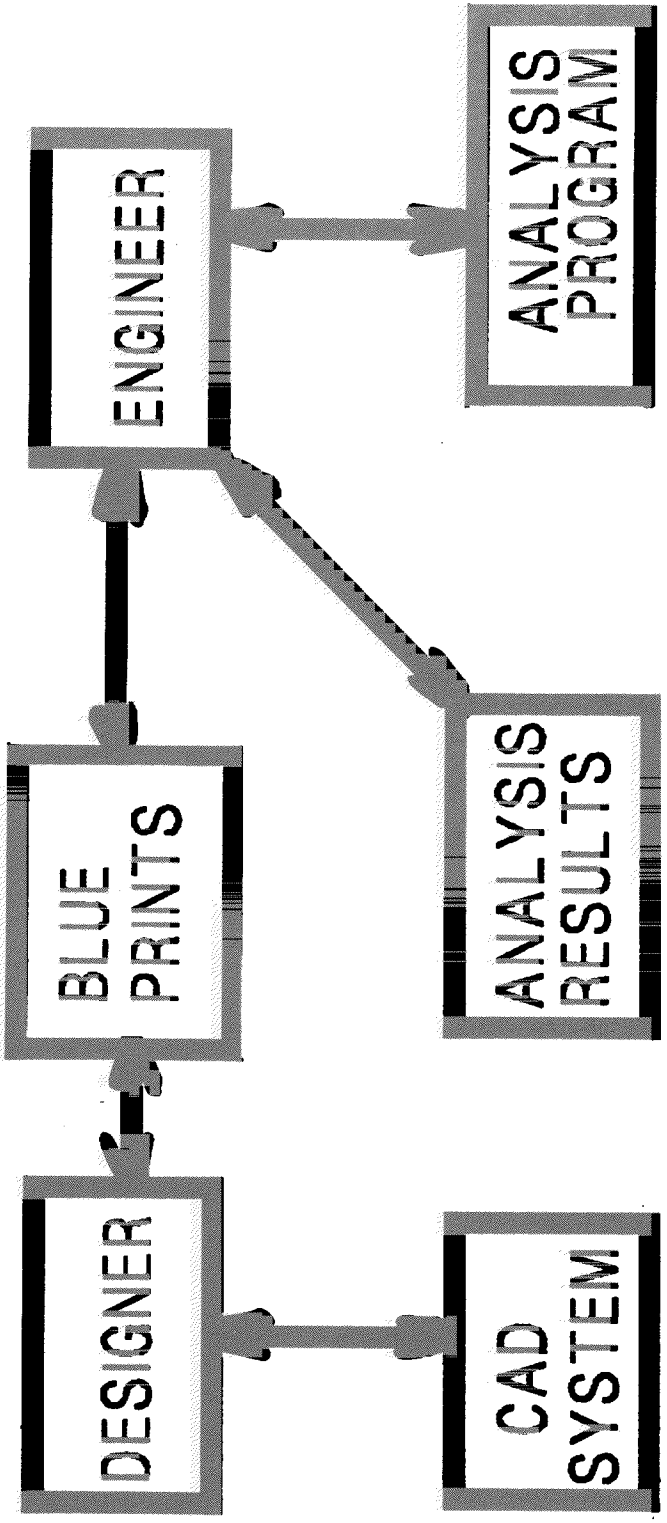
## **PROBLEMS**

Although the idea of a data link between CAD and ANALYSIS is not new, progress has been slow due to the number of CAD systems, ANALYSIS programs, and MODELING programs. Considering the number of systems, there are hundreds of possible combinations of CAD, ANALYSIS, and MODELING programs.

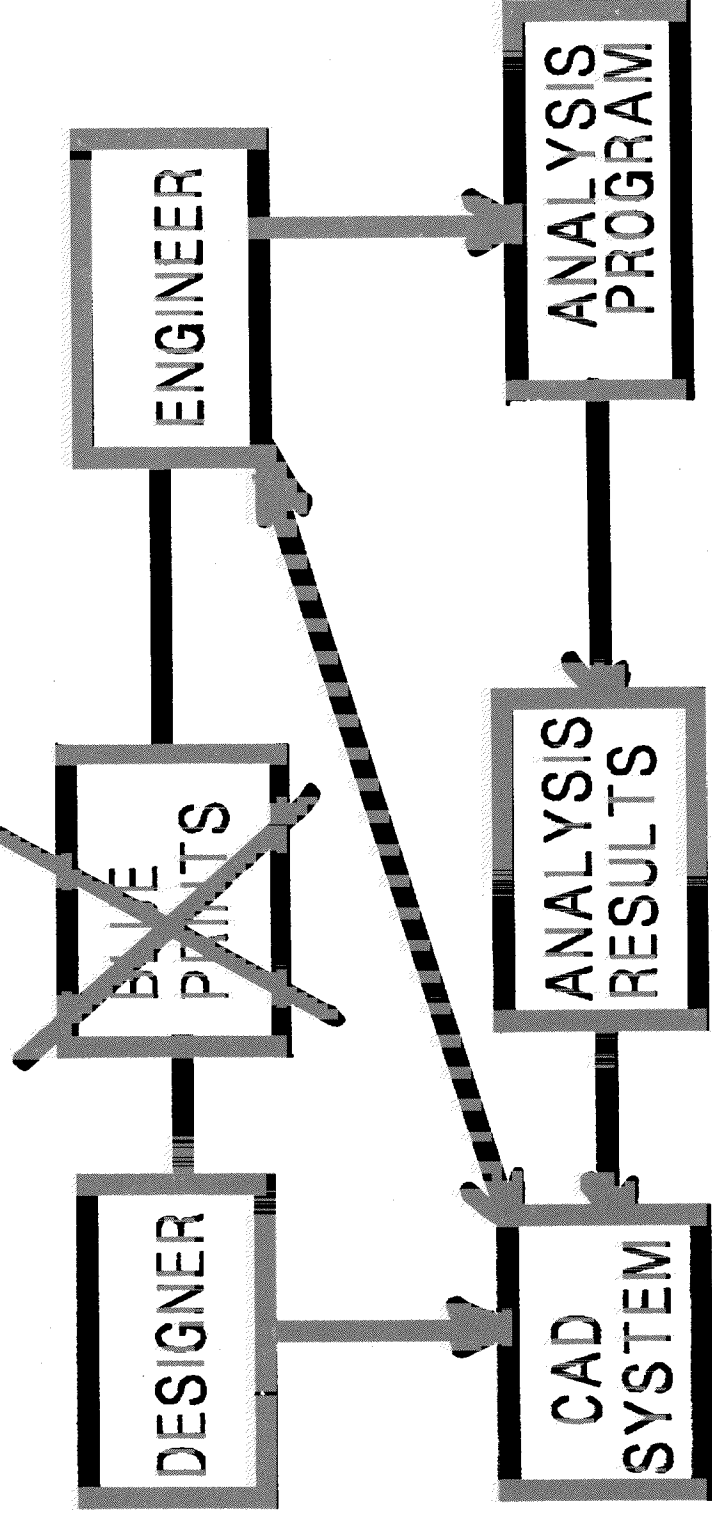
Integration requires a view of the big picture of the system, as well as an elaboration of the specific functions of candidate ingredients. When assembling comprehensive systems for all computer-aided functions, buying different packages from several vendors is unavoidable. When CAE implementation was small-scale, it was practical to have a turnkey vendor provide all of the software. However, now that corporations are moving out of the experimental and evaluation phase of CAE, the scope of activities tends to grow beyond turnkey approaches. Because of the multivendor approach, conciseness has become an issue in configuring the CAE system. Ideally, users would prefer that each vendor choose one particular function and perform that one task well. Instead, it appears that many vendors are trying to cover too many bases and failing to cover them properly.

Today, only a few if any, vendors offer users concise, unbundled, and integrated solutions. Some products that excel at integration lack conciseness and vice versa.

# FLOW DIAGRAM OF A TYPICAL ENGINEERING ANALYSIS



# FLOW DIAGRAM OF A ~~TYPICAL~~ ENGINEERING ANALYSIS INTEG.



HOW INTEGRATED SYSTEMS WILL HELP INCREASE  
THE PRODUCTIVITY OF ANALYSIS

1. CENTRAL DATABASE APPROACH

0 DRAWINGS ARE FOCAL POINTS FOR ENGINEERING ENVIRONMENT.  
BUT NOW DRAWINGS ARE DEVELOPED IN CAD SYSTEM  
AND STORED IN DATABASE.

0 CAD DATABASE IS BECOMING FOCAL POINT TO DEVELOP  
ANALYSIS MODELS.

- ATTRIBUTES
- MANUFACTURING
- PURCHASING

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0 DATABASE: CENTRAL LOCATION FOR INFORMATION RETRIEVAL.

LESS TIME SPENT ON LOOKING UP REFERENCE INFORMATION.

HOW INTEGRATED SYSTEMS WILL HELP INCREASE  
THE PRODUCTIVITY OF ANALYSIS

2. MINIMIZES POSSIBILITY OF ERRORS
  - o CHANGES MADE IN MODEL ARE UPDATED TO DATABASE AND DOCUMENTATION AUTOMATICALLY.
3. INTEGRATION ACCELERATES DESIGN AND DEVELOPMENT CYCLE OF PRODUCTS.
  - o AEROSPACE AND AUTOMOTIVE INDUSTRY ARE FACING DEVELOPMENT TIME PRESSURE.
  - o DESIGN MUST BE VERIFIED BEFORE COMMITMENT TO A MANUFACTURING PROCESS.

HOW INTEGRATED SYSTEMS WILL HELP INCREASE  
THE PRODUCTIVITY OF ANALYSIS

4. INTEGRATION OF CAD AND ANALYSIS PROVIDES  
SIGNIFICANT HEADSTART TO BUILD ANALYSIS MODEL.
5. PROVIDES MECHANISM FOR RAPID MODIFICATION OF MODEL.  
AND FOSTERS PRODUCT OPTIMIZATION.
6. HIGHER ACCURACY.  
ACCURATE GEOMETRY HELPS TO INCREASE ACCURACY OF ANALYSIS.
  - 0 PHYSICAL PROPERTIES NEEDED FOR ANALYSIS.
  - 0 EXAMPLE : VIBRATION ANALYSIS
  - 0 MASS DISTRIBUTION PLAYS SIGNIFICANT ROLE.
  - 0 ACCURATE GEOMETRY DATABASE HELPS TO ACHIEVE  
ACCURATE MASS DISTRIBUTION.

HOW INTEGRATED SYSTEMS WILL HELP INCREASE  
THE PRODUCTIVITY OF ANALYSIS

7. INTEGRATION PROCESS GIVES A COMPANY AN OPPORTUNITY TO RETHINK THE WAY IT DESIGNS AND CREATES PRODUCTS.
8. INTEGRATION OF CAD AND ANALYSIS RESULTS IN DEVELOPING SUPERIOR END PRODUCT.
9. STANDARDIZATION OF COMPUTERS AND CAD/CAM SYSTEM.
10. INFORMATION IS ORGANIZED IN A SYSTEMATIC MANNER.



HOW INTEGRATED SYSTEMS WILL HELP INCREASE  
THE PRODUCTIVITY OF ANALYSIS

11. DIVISION BETWEEN DESIGN, ANALYSIS AND  
MANUFACTURING WILL BECOME SMALLER.
  - o DEVELOPMENT IN DESIGN DATABASES
  - o ANALYSIS MODELER (MESH GENERATOR)
  - o COMPUTER-AIDED ANALYSIS.
12. INTEGRATED SYSTEM IS ATTRACTIVE ALTERNATIVE TO PROTOTYPE.
13. INTEGRATED SYSTEM BRINGS DESIGN AND AUTOMATED  
TEST FUNCTIONS CLOSER.
14. THE INTEGRATION ALLOWS TOP LEVEL CORPORATE COMMITMENT AND  
REORGANIZATION OF ENGINEERING DEPARTMENT.

HOW INTEGRATED SYSTEMS WILL HELP INCREASE  
THE PRODUCTIVITY OF ANALYSIS

15. COMBINATION OF ENGINEERING SKILLS FOR GREATER PRODUCTIVITY.
  - o DESIGNER IS ACCUSTOMED TO COMPUTER MANIPULATION OF GEOMETRIC DATA ON CAD SYSTEM.
  - o AFTER TRAINING IN MESHING AND THEN UNDER ENGINEER'S GUIDANCE AND SUPERVISION, DESIGNER CAN MAKE MESH.
  - o ENGINEER INTERPRETS THE RESULTS.
  - o MORE PRODUCTIVE UTILIZATION OF ENGINEER'S TIME.  
BETTER USE OF ENGINEERING TALENT THAN DEVELOPING GEOMETRY AND MESH.