In the Matter of          )

)

)        **Docket No. 9299**

MSC.SOFTWARE CORPORATION,   )

a corporation.         )    **PUBLIC RECORD VERSION:**

)

## COMPLAINT COUNSEL'S PRETRIAL PROPOSED FINDINGS OF FACT

Complaint Counsel present below our pretrial proposed findings of fact setting forth facts that Complaint Counsel plans currently to present at trial in our case in chief in this proceeding challenging Respondent MSC.Software Corporations acquisitions of Universal Analytics, Inc. and Computerized Structural Analysis and Research Corporation. Complaint Counsel continues to review the evidence, including the ongoing discovery and substantial discovery recently completed. Complaint Counsel reserves the right to provide further citations to documents and testimony presented at trial that supports these finding of fact and to supplement these findings. Complaint Counsel present separately its pretrial brief and pretrial proposed conclusions of law containing the legal principles that guide consideration of the issues in this proceeding.[1]

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[1] The following examples explain the citations that complaint counsel is using in its briefs: "CX-1 at MS-0000697" refers to the exhibit number assigned by Complaint Counsel with the bates number page containing the relevant information; "   Dep. at 27:1 to 30:8" refers to the deposition of       at page 27, line 1 through page 30, line 8; "   IH at 27:1 to 30:8" refers to the investigational hearing of    at page 27, line 1 through page 30, line 8.

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# I. The Merged Parties

## A. MSC.Software Corporation

### 1. Background

1. Respondent MSC.Software Corporation, formerly MacNeal-Schwendler Corporation, is a Delaware corporation traded on the New York Stock Exchange. Its 2001 revenues were $236 million. It employees approximately 1350 persons in offices around the world.

2. In the late 1960s, MSC became a contractor to National Aeronautics and Space Administration ("NASA"), developing a linear structural analysis software product called Nastran, which is an acronym for "NASA Structural Analysis System."

3. MSC claims to be the leading supplier of mechanical computer-aided engineering products. It offers a wide range of different finite element analysis ("FEA") products designed to meet different types of simulation needs and levels of user sophistication.

CX-1839; CX-921; (MSC)
IH at 272 (CX-1526); CX-13; CX-14; CX-1654); ) IH at 76-77 (CX-1418); CX-1623 at MS-0005861 to 67; CX-1568 at MS-0002440.

4.

MSC also offers an e-commerce marketplace to serve the engineering industry at www.Engineering-e.com.

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CX-1623 at MS-0005856 to 59;          IH at 147-48 (CX-2515).


5.

CX-2260.


### 2.    MSC's Nastrans Product Line

6.    MSC offers several levels of Nastran solvers with differing features and capabilities. "MSC Nastran" is MSC's full-featured, advanced version of Nastran.


It is the most powerful and fastest version of Nastran with the ability to analyze the largest models. This advanced version of Nastran also offers the broadest range of FEA features and capabilities and interfaces with many additional speciality modules and applications. It also is the most flexible in allowing user to alter the analysis and output sequence. MSC's limited-featured versions of Nastran offer abridged features and capabilities and are available at markedly lower prices than the price for MSC Nastran. Additionally, MSC's limited-featured Nastran provides only standard or "rigid" analyses and output data sequences without the user being able to customize the analysis or output. MSC also offers two desktop versions of Nastran with even less capabilities and

features.  CX-1915; CX-1914;        IH at 185-87, 251, 256 (CX-1505); CX-1857 at MS-

0002352; CX-916; CX-1025; CX-1641 at 8635;      Dep. at 106:13 to 108:2 (CX-1416);      Dep.

at 98:12 to 99:16 (CX-1520).

### 3.    MSC's Licencing Revenue

7.

CX-2750; CX-1521; CX-1522.

8.

CX-2379; CX-13; CX-14;

CX-1654; CX-1621; CX-1521; CX-1522.

9.

CX-2751; CX-1521; CX-1522.

### 4. MSC's Nastran Customer Base

10. The following table sets forth MSC's ten largest U.S. accounts ranked in order of purchases of MSC Nastran over the period 1996 through 1998 (CX-1521; CX-1522):

| Rank | Customer | MSC Nastran Revenue for 1996-1998 for Each Customer Unit | Percent of MSC'S Total 1996-1998 Nastran Revenue | Cumulative Total percent of MSC'S 1996-1998 Nastran Revenue |
|------|----------|------|------|------|
| 1 | | $ | | |
| | | $ | | |
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| Rank | Customer | MSC Nastran Revenue for 1996-1998 for Each Customer Unit | Percent of MSC'S Total 1996-1998 Nastran Revenue | Cumulative Total percent of MSC'S 1996-1998 Nastran Revenue |
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| 8 |  |  |  |  |

| Rank | Customer | MSC Nastran Revenue for 1996-1998 for Each Customer Unit | Percent of MSC'S Total 1996-1998 Nastran Revenue | Cumulative Total percent of MSC'S 1996-1998 Nastran Revenue |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| 9 | | | | |
| 10 | | | | |
| | TOTAL REVENUE FROM LISTED CUSTOMERS | $ | | |
| | TOTAL MSC WORLDWIDE NASTRAN REVENUE | $ | | |

### 5. MSC Has Grown Substantially Through Acquisition

11. In 1994, MSC acquired PDA, a producer of pre and post processing software, namely Patran. CX-2513

12. In 1998, MSC acquired Knowledge Revolution, the leading developer and distributor of 2D

and 3D motion simulation software for design engineers and analysts.

13. In 1998, MSC acquired Silverado Software & Consulting, Inc. (SSC), a provider of engineering services and custom software solutions.        Dep. at 94:3 through 11 (CX-1497); IH at 47:3 through 25 (CX-1526)

14. In 1999, MSC acquired MARC Analysis Research Corporation, a developer and distributor of simulation software for non-linear analysis. CX-1507; CX-1852..

15. In 1999, MSC acquired Universal Analytics, Inc., a competing supplier of Nastran solvers. CX-1507; CX-1852.

16. In 1999, MSC acquired Computerized Structural Analysis and Research Corporation, a competing supplier of Nastran solvers. CX-1507; CX-1852.

17. In 2001, MSC acquired Advanced Enterprise Solutions, Inc., a reseller of computer hardware and engineering softwareware. CX-2755; CX-2756

18. In 2002, MSC acquired Mechanical Dynamics Corporation, a supplier of engineering software for testing. Perna Dep. at 263:12 through 264:4 (CX-1497).

**B. MSC's Acquisition of Universal Analytics, Inc.**

### 1. UAI

#### a. Background

19.  UAI has supplied engineering software since the early 1970s. Its primary software product was UAI Nastran. During the period 1973-80, UAI succeeded MSC as a developer of Nastran for NASA and thereafter began offering a commercial version of Nastran.

IH (CX-1527);          Dep. (CX-1496).

20.

(          ) IH at 21 (CX-1527); CX-1; CX-1613 at MS-0004166 to 79.

#### b. Product Line

21.  At the time of its acquisition by MSC, UAI was offering Nastran for supercomputers, multi-user server computers, Unix workstations, and PC Windows platforms.          IH at 87, 112-13; CX-1527.

22.  UAI also offered several complementary Nastran products for data base management and visualization. CX-1544;          IH at 163-64 (CX-1527).

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23. UAI developed a commercial version of Astros, a government-funded aerospace solver derived from Nastran under a U.S. Air Force contract. Astros, a 13-year, $6 million development program, provided structural optimization for light aircraft wings.                   IH at 96-97, 137 (CX-1527);                                    ; CX-1613 at MS-0004166 to 79; IH Ex. 8 at 4197 (CX-1616); CX-1914 at 16; CX-1512

### c. Customer Base

24. The following table sets forth UAI'S six largest licensors of UAI Nastran based upon sales over the three-year period 1996 through 1998 (C. :-1521; CX-1522):

| Rank | Customer | UAI's Revenue for 1996-1998 | Percent of Total UAI 1996-1998 Revenue | Cumulative Total Percent of UAI's 1996-1998 Revenue | Source |
|---|---|---|---|---|---|
| 1 | | | | | CX-2346 at MS-22 003203 to 3204 |
| 2 | | | | | Dep. at 130,148-149 (CX-2514) |
| 3 | | | | | CX-352 at |

| Rank | Customer | UAI's Revenue for 1996-1998 | Percent of Total UAI 1996-1998 Revenue | Cumulative Total Percent of UAI's 1996-1998 Revenue | Source |
|------|----------|------------|-----------|-----------|--------|
| 4 | | | | | CX-1100 at |
| 5 | | | | | Dep. at 92-93 (CX-1414); CX-2346 at MSC-22 003203 to 3204 |
| 6 | | | | | CX-111 at ; CX-146 at ; CX-2346 at MSC-22 003203 to 3204 |

### 2. The Acquisition Transaction

25. MSC acquired the stock of UAI on June 24, 1999, for approximately $8.4 million in cash. CX-2771 MSC10K (for years ending Dec. 31, 2000).

26.

CX-1409 (MSC's Response to CC's Interrogatory No. 12); Dep. at 323:14 to 326:4 (CX-1496).

### 3. MSC's Understanding of the Effect of the Acquisition of UAI

27. MSC's management stated that the acquisition of UAI would

10

28.

CX-1at MS-
0000699.


29.



CX-2365 at MSC-22 004827.

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**C.    MSC's Acquisition of Computerized Structural Analysis & Research Corp.**

**1.    CSAR**

**a.    Background**

30.    CSAR was a privately-held, worldwide supplier of engineering software


CX-1939;                    IH at 233 (CX-2764).



**b.    Product Line**

31.    CSAR's primary product was CSAR Nastran which it offered on all computer

platforms. CSAR

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also engaged in customer-funded Nastran development. CX-1914 at 45; IH at 201-02 (CX-2764).

32. CSAR's product line also included GENSA, a non-linear structural analysis tool. Dep. at 94:6-8 (CX-1498).

33.

34. CSAR began business in the early 1980s. It undertook development work for MSC and provided Nastran consultation and training services. It released its first commercial version of Nastran in 1988.

IH at 12-16, 202-04; 405 (CX-2764); CX-835 at 0863; CX-1788; CX-834.

### c.    Customer Base

35. The following table sets forth CSAR'S six largest licensors of CSAR Nastran based upon revenue for the period 1996 through 1998.

| Rank | Customer | Total CSAR's 1996-1998 Revenue | Percent of Total CSAR 1996-1998 Revenue | Cumulative Total Percent of CSAR's 1996-1998 Revenue | Source |
|---|---|---|---|---|---|
| 1 | | | | | Dep. at 191-192 (CX-1457) |
| 2 | | | | | CX-111 at |
| 3 | | | | | |
| 4 | | | | | CX-422 at |
| 5 | | | | | CX-1925 at MSC-74 001522 to 23; CX-2439 at MSC-74 001703 to 05; Dep. at 189-199, 255-258 (CX-1415) |
| 6 | | | | | |

### 2. The Acquisition Transaction

36. MSC acquired CSAR on November 4, 1999, for approximately $10 million in cash and warrants. CX-2750; IH at 251 (CX-2764); IH at 234, 238

(CX-1505).

37.

IH at
206–07 (CX-1505);                              IH at 168 (CX-1418); MSC's Response to CC's

Interrogatory No. 12 (CX-1409).


### 3. MSC's Understanding of the Effect of Its Acquisition of the CSAR

38.   MSC's management stated

CX-2:


39.

CX-2 at

MS-0000741.

*See* CX-2;

CX-2278 at MSC-164 000261; CX-3 at MS-008634 (                    ).


40.

CX-2365 at MSC-22

004827.

## II. Commerce

41.    MSC, UAI, and CSAR were engaged in commerce as that term is used in the FTC Act and in the Clayton Act.

## III. The Relevant Product Market Is Comprised of MSC Nastran, UAI Nastran, and CSAR Nastran

### A.    The Three Advanced Nastrans Share Unique Market Characteristics

#### 1.    The Three Nastran Solvers Derived from the Same NASA Development Program

1.    In 1966, NASA initiated development of a digital computer program for large scale linear structural analysis using the finite element method of analysis. NASA's project team completed the first version by 1969, naming it "NASA Structural Analysis System" or "Nastran."

CX-1403 (R. H. MacNeal, *The MacNeal-Schwendler Corporation · The First Twenty Years* at 37-58 (1988);

; CX-165 at                    ;CX-166 at

;    CX-167 at                    .

2.    In developing Nastran, NASA sought to unify computerized structural analysis for NASA and users throughout the aerospace industry.  By adopting a common solver standard for its centers, contractors, and subcontractors, NASA believed that its projects could proceed more easily and efficiently, saving time and money.  Nastran achieved that goal because it consolidated a series of

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structural mechanical analysis tools into a single, flexible general purpose computer program. Anticipated testimony of                   .

3.     Following NASA's initial development of Nastran in the early 1970s, NASA released the Nastran source code into the public domain.  To facilitate the release, NASA contracted with an affiliate of the University of Georgia known as Computer Software Management and Information Center ("COSMIC")  to distribute and maintain the code.   While Cosmic maintained the code, it added few new features or capabilities.  COSMIC ceased maintaining the code in 1994.  Today, copies of NASA's Nastran source code are available directly from NASA. CX-1914 at 6; CX-1403 (R. H. MacNeal, *supra*, at 37-58); Anticipa. .d testimony of

4.

                        CX-1914 at 6; CX-1403 (R. H. MacNeal, *supra*, at 37-58); Anticipated testimony

5.     Nastran performs computer-aided simulation through the finite element analysis method ("FEA").  The finite element method is particularly useful for analyses of structures and

16

mechanical components, including analysis of stress and deflection, vibration, and buckling response. The finite element method takes its name from the "elements" or blocks formed by a computerized electronic mesh or grid applied to a 2-D or 3-D CAD drawing of the design structure. The electronic grid applied to the CAD drawing is generated using a "pre-processor," also known as a modeler. The pre-processor further generates a text file that describes each element in the grid and the composition and physical properties of the structure. The text file becomes the input file that is subject to the finite element analysis. The software performing the analysis is known as the "solver." The solver is comprised of engineering algorithms that reflect the laws of physics. The solver supplies the results of the analysis in a text output file. The user then employs a "post-processor" to convert the text output file into 2-D or 3-D drawing for visualization of the affects of the load on the structure. CX-1191; White Paper at 19-20, 38, 45 (CX-1914); IH at 67, 119-21, 241 (CX-1418).

6. While Nastran was one of the first FEA solvers developed, it is now one among many FEA solvers. FEA solvers vary widely according to the type or range of problems that can be solved, the size of the problem, the speed of the analysis, and the computer platform on which the solver operates. General purpose solvers like Nastran offer capabilities to solve a wide range of problems while special-use or application-specific solvers offer specialized capabilities. There is no solver capable of solving all engineering problems. Thus, an analyst may need to use several different solvers if a broad range of analyses is needed. CX-1914 at 29-31; CX-1904.

17

7.      Nastran became a widely-used, powerful solver for advanced linear structural analysis

for large systems analysis as well as component analysis.  Its ability to analyze a wide range of

engineering problems reduces the number of different solvers a user may need.  CX-1845 at MS-

0009648 to 9677;                                ) IH at 63-64 (CX-1527);                IH at 33-39 (CX-

2764).


8.      Having been developed by NASA with features and capabilities needed and used for

aerospace work, Nastran was well suited for the aerospace industry.  Nastran was developed to

undertake analysis of large scale structures found in the space program.  These same

characteristics are also found in the aerospace industry.


9.      Nastran's other strengths were also well suited for the aerospace industry, including

static, dynamic, linear, stress, vibration, deformation, deflection, aeroelasticity, motion, and

buckling response analyses.  These capabilities make Nastran the standard solver in the aerospace

and defense industries.  Nastran was developed as a linear analysis tool and nearly all design

criteria in those industries are based upon linear analysis and the vast majority of all strength and

vibration analyses are linear.  Moreover, Nastran is a tool that enables the user to easily modify

or "alter" the sequence of analysis and output data.  Such flexibility is often important in the

aerospace and automobile industries.  CX-1895 at MS-0009648 to 9677;

IH at 63-64 (CX-1527);                        IH at 33-39 (CX-2764); CX-1569 at MS-0002535;

10. Nastran also was well suited for the auto industry because automobiles, like aerospace structures, are large scale structures. Nastran enabled the auto makers to design lighter automobiles that would be more fuel efficient while maintaining a quiet automobile that could withstand real-world conditions.

11. Nastran users have increasing appetite for greater Nastran features and capabilities. Users are seeking to analyze ever larger problems and to conduct new and more precise analyses that requires added development and enhancements and faster and more efficient software.

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Customers routinely urge their Nastran suppliers to continue the development and enhancement of Nastran, including the speed and efficiency of Nastran to better meet their needs. CX-1200; CX-804; CX-843; Anticipated testimony           Dep. at 167-69 (CX-1520); Dep. at 241-43 (CX-1527);      Dep. at 98 (CX-1413);

        Dep. at 71 (CX-2514).

12. Computer-aided simulation has become an important part of the process of designing new, better, and safer products. By simulating real world conditions on a structure and measuring the response of the structure, computer-aided simulation reduces development costs, shortens the

time for new product development, and ensures public safety. CX-1914 at 7; CX-2776 (MSC Annual Report (1998)).

13.     Nastran is also used in critical applications. Its cost is small compared to the total costs of the overall project where it is used. CX-1914 at 7; CX-2776 (MSC Annual Report (1998)).

14.     Not only has Nastran grown by the inclusion of higher-end modules, but MSC, UAI, and CSAR have also developed an abridged, or lower-end version of Nastran used by design engineer. Design engineers tend to specialize in product design and not analysis. They have recently begun to use solvers in the design process. They tend to use easy-to-learn, lower-end solvers with fewer features and capabilities. They also have less need for programming flexibility and speed. Design engineers generally operate on a PC Windows 95, or NT platform environment.

### 2.     MSC, UAI, and CSAR Followed Similar Paths to Developing Their Advanced Nastrans to Meet the Needs of the Same Customer Base

15.     MSC began offering its own enhanced version of Nastran for commercial use in the early 1970s. MSC had been a contractor to NASA in the initial development of Nastran and, thus, was already intimately familiar with Nastran. CX-1403.

16.     Shortly thereafter, UAI began offering its own enhanced version of Nastran for commercial use. UAI had been the second developer of Nastran for NASA after MSC's Nastran contract work for NASA. CX-1403;          IH (CX-1527)


17.     In the late 1980s, CSAR began offering its own enhanced version for commercial use. Anticipated testimony of                              IH at 15-16 (CX-2764).


18.

                    (CX-1527);          IH (CX-2764)


19.     The three Nastran suppliers sought to meet these growing needs of the aerospace and automotive industries and other industries for Nastran analysis.


                    Dep. (CX-1518);      Dep. (CX-1527);

IH (CX-1527).


20.     The three Nastran suppliers tracked each other's development and competed to supply new Nastran technology or to enhance Nastran with new features and capabilities at the lowest price. CX-839 at                  ; CX-1569 at MS-0002536.


21.

001957.

22.  Following is a list of new features where the three Nastran supplies were actively
seeking to develop prior to MSC's acquisitions of UAI and CSAR:

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- ●

- ●

- ●

CX-1422 at MSC File 3065, Box 10-3; CX-839; CX-2076.

23.

CX-2387 at MSC-33 000010 to

18; CX-2517 at MS-0002549, 2551.

24.

IH at 169-

70 (CX-1527);          IH at 29-31 (CX-2764);                    IH at 55-56 (CX-

1418); CX-2517 at MS-0002535, 2549, 2551.

25.          .          .

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Examples of additional

analysis tools that use Nastran output files are MSC/MDI's ADAMS and LMS's Sysnoise. Both

analysis tools analyze kinematics (motion and jarring), acoustics, and durability.

IH at 169-70 (CX-1527);                    IH at 29-31 (CX-2764);

IH at 55-56 (CX-1418); CX-2517 at MS-0002535, 2549, 2551.

26.     Suppliers of engineering software that conduct such further analysis of Nastran output files require access to computer interfaces with Nastran in order to perform their analysis.

IH at 169-70 (CX-1527);             IH at 29-31 (CX-2764);             IH at 55-56 (CX-1418).


27.

. CX-2304 at MSC-18 0021091.


28.     These versions of Nastran, having evolved to offer the most advanced enhancements, can appropriately be described, "advanced versions" of Nastran.


CX-2390 at MSC-38 000183; CX-2389 at MSC-38 000166; CX-2447 at MSC-74 005222 to 34; CX-1025; CX-2365 at MSC-22 004827.


29.


CX-1569 at MS-0002549, 2551;          IH at 110, 140, 206, 228, 256-57 (CX-1505);          IH at 85, 95 (CX-1418); CX-1623; CX-2751.

30.     Professional analysts tend to use solvers in a multi-user environment, including

supercomputers and multiuser services.


          CX-1640 at 8622 (CX-1640).  Professional analysts commonly are using Nastran

with a Unix operating system.  The Unix operating system has been popular in the scientific,

engineering, and technical communities.  The Unix operating system is well-suited to multi-user

servers and network systems as well as individual workstation computers.


31.

     IH (CX-1527)


**B.    MSC, UAI, and CSAR Each Viewed the Other Advanced Nastrans as Direct
       Competitors**

   **1.    MSC's Business Decisions Reflect Direct Competition Between the
          Advanced Nastrans**

       **a.    MSC Viewed UAI Nastran and CSAR Nastran As Its Primary
              Competitor for Advance Nastran Customers**

32.

CX-2373 at MSC-22 009400 to 9408; CX-18.

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33.

CX-2466 at MSC-74 023085.

34.

CX-

21; CX-2465 at MSC-74 023057 to 58; CX-19;          IH at 99 (CX-1418).

35.                                                              . CX-

1657;                                   ; CX-2155 at MSC-149 003226 to 27.

36.

CX-2375 at

MSC-22 009481 to 9486.

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37.

CX-

16;        IH at 32-33 (CX-1505);

MSC Ex 20 at 8622 (CX-1640).

38.

CX-5; CX-19; CX-2465 at MSC-74 023057 to 58.

39.

CX-14;        IH at 242, 245 (CX-2515); CX-5; CX-19 at

1518-19.

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b.    **MSC Lowered Its Prices and Increase Its Development Effort in**

40.

CX-13; CX-14 at 2029;        IH at

242, 245 (CX-2515).

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41.

CX-2278 at MSC-164 000273 to 74; CX-2379 at

MSC-25 0004716 to 19.

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42.

CX-2742 at MS-0006571 to 76; CX-14; MSC Ex. 4 at 1518 to 19 (CX-19); CX-7; CX-1557;

CX-2466; CX-824          o 752; CX-980; CX-1833.

. . .

43.

                                                                CX-8.

44.

                                        CX-2278 at MSC-164 000273 to 74; CX-2375 at MSC-25

0004716 to 19;        IH at 140, 151, 159 (CX-2512);                        IH at 204 (CX-

2515);        IH at 75-76, 270 (CX-1418); CX-1914 at 14, 25-26; CX-14; CX-16; CX-980;

CX-1380; CX-19; CX-3.

45.   In responding to pricing pressure from UAI Nastran and CSAR Nastran, MSC has

been able to target lower prices or greater discounts to individual customers without lowering

prices to all customers.  MSC has been able to target discounts on the customers who are more

likely to switch to UAI or CSAR.

46.

CX-2191; CX-2097.

47.

CX-1657.

48.

CX-21.

49.

CX-

14;        , IH at 242, 245 (CX      5).

50.   MSC faced the threat that customers would switch to UAI Nastran and CSAR Nastran

CX-15 at MSC-02 002252; CX-

2276.

51.

H at 239-40 (CX-1527);

31

IH at 147-49, 170 (CX-1505);                               at 242 to 243 (CX-2515);

IH at 166-67, 254 (CX-1418);                    IH at 165 (CX-1505).


52.


CX-1562.


        **c.**    **MSC Believe:     .i Nastran and CSAR Nastran Posed an Even Greater Competitive Threats If Acquired by Another Engineering Software Vendor**

53.


CX-1914 at 16-17, 17, 26-

27; CX-20; CX-21; CX-1; CX-2;          IH at 166-68. 239 (CX-1505);

IH at 88-89 (CX-1418);                    IH at 205-06 (CX-1526); CX-3 at MS-

0008634.

### d. MSC Targeted UAI Nastran and CSAR Nastran for Exclusion Because They Were Competing Products

54. The prospect of customers switching to either UAI Nastran or CSAR Nastran caused MSC to consider adopting or even adopting strategies that would impede UAI Nastran's and CSAR Nastran's ability to compete.

CX-14;

IH at 82-83 (CX-1418); CX-21; CX-1832; CX-2155 at MSC-149-003226 to 27.

55. MSC had developed some complementary software that would use only MSC's proprietary output file, XDB, rather than the Nastran output 2 file.

CX-13;

CX-14.

56.

Anticipated testimony of                ; CX-1050 at                .

57.

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CX-19;          IH at 103-04, 228-29 (CX-1418).

58.

IH at 51-56 (CX-2515);       CX-1657 at MS-

0009779 to 80.

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e. **MSC Acquired UAI and CSAR to Eliminate Competition**

59.

CX-2365 at MSC-22 004827.

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60.

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CX-2108; CX-1939;          IH at 214-16 (CX-1505);                    IH at 195-97,

205 (CX-1526).

61.

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CX-2293 at MSC-18 018699;

IH at 163-65 (CX-1505).

62.

CX-2 at MS-000741;

IH at 184, 260 (CX-1526);          IH at 242 (CX-2515);          (MSC) IH at

34-35, 89-90 (CX-1526).


63.                    -ik. --


CX-2 at MS-

000741;              IH at 184, 260 (CX-1526);          IH at 242 (CX-2515);

IH at 34-35, 89-90 (CX-1526).


64.

CX 1854 at MS-0002031, 2035; White

Paper at 16-17, 26-27 (CX-1914); CX-1620;                    IH at 89-89 (CX-1418); CX-

1557 at MS-0001911;                    IH at 205-:. : [CX-1526).


65.    As highlighted in the section below regarding anticompetitive effects of the

acquisitions, MSC undertook certain steps after the acquisition that it could not accomplish pre-

acquisitions because of competition from UAI and CSAR.  Since the acquisitions,

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        –                                                        .


        –


        2.    **UAI Based Business Decisions on Prospect that Users Would Substitute
              UAI Nastran for MSC Nastran**

66.

Dep. at

88-89,132 (CX-1496); CX-5; CX-1610; CX-1572; CX-1914 at 26;

Dep. at 131 (CX-1496); CX-2767; CX-2768.


67.                                                        CX-1583; CX-1585;

CX- 1587; CX-1581 at MS-0003005 to 3008.


68.

IH at 87, 112-13; 158 (CX-

1527).


69.


IH at 85-89, 135-36, 141-42, 162 (CX-1527); CX-1610.


70.

Dep. (CX-1414).


71.   UAI licensed Nastran through annual and paid up licenses similar to MSC's pricing

system.

72.

Dep. (CX-1496);     IH (CX-2764).

73.

CX-6;     Dep. at 152 (CX-1417).

74.

75.

IH (CX-1527);    Dep. (CX-1496);    Dep. (CX-1764).

76.   UAI had development projects underway that would continue to threaten MSC.

These development projects included Astros

IH (CX-1527);    Dep. (CX2764).

.

77.

CX-1362.

78.

Dep. (CX-1496).


### 3. CSAR Based Business Decisions on Prospect that Users Would Substitute CSAR Nastran for MSC Nastran

79.                                                             IH at 128-129,

207, 214 (CX-2764).


80.                                                             IH at 99-103,

122, 124-29 (CX-2764);                    ) IH at 245, 252 (CX-2515);                    IH at 184

(CX-1527);                    IH at 101(CX-1418); CX-1530; CX-2084; CX-2082.


81.




CX-8 at MS-0003250, 3287.


.

82.

.

CX-8 at MS-0003279; CX-1557 at MS-0001880, 1918.

83.

IH at 99-103, 122, 124-29 (CX-2764);                    IH at 245, 252 (CX-

2515);                    IH at 184 (CX-1526);                    IH at 101 (CX-1418); CX-

1530; CX-1408; CX-1409; CX-1410; CX-1411.

84.

IH at 99-103, 124-29, 263-64 (CX-2764); CX-8 at  MS-0003279;

at 194, 203 (CX-1505).

85.    CSAR had been successful in securing business at

86.

CX-2385; CX-1981 at MS-02 003917.

### 4.    Other Engineering Software Vendors Considered the Three Advanced Nastran as Close Competitors

87.

CX-1179.

88.

CX-2629 at      08891.

**C.    Users Switched or Considered Switching Among the Three Advanced Nastrans**

89.    Customers have switched between advanced versions of Nastran from MSC, UAI, and CSAR in response to price or other competitive variable.  Following the acquisitions, they could only switch to other solvers, which were more distant substitutes in response to higher prices or reduced output of other competitive variables.

90.

## PRESENCE OF UAI NASTRAN AND CSAR NASTRAN
## AT TEN LARGEST LICENSORS OF MSC NASTRAN[2]

| Rank | CUSTOMER | UAI NASTRAN LICENSES | CSAR NASTRAN LICENSES | SOURCE |
|------|----------|----------------------|-----------------------|--------|
| 1 | | | -- | Dep. at 177 to 178 (CX-1491); CX-2435 and CX-2437 at MSC-74 001561; CX-2431 at MSC-74 001703 to 05; CX-1787 at MS-0025379; Dep. at 230 (CX-1525); Dep. at 145 (CX-1414); Dep. at 189-199, 255-258 (CX-1415); Dep. at 204 (CX-1492); IH at 45-47 (CX-2515); CX-2155 at MSC-149-003226 |

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[2]  The identified references include the MSC, UAI, and CSAR data sets.

| Rank | CUSTOMER | UAI NASTRAN LICENSES | CSAR NASTRAN LICENSES | SOURCE |
|---|---|---|---|---|
| 2 | | | | CX-426 at - 03-1003 to 08; CX-452 at - 000092; Dep. at 99 (CX-1413); CX-473; CX-428 |
| 3 | | | | |
| | | | | CX-117 at -0243 to 51 |
| | | | | CX-1922 at MSC-70 000360; CX-1496 |
| | | | | |

| Rank | CUSTOMER | UAI NASTRAN LICENSES | CSAR NASTRAN LICENSES | SOURCE |
|---|---|---|---|---|
| 4 | | | | Dep. at 36, 53, 82-83 (CX-1457) |
| 5 | | | | CX-1234 at 466; IH at 114-16, 127 (CX-1527) |
| 6 | | | | Dep. at 94-95 (CX-1414); IH at 45-46 (CX-2515). |
| 7 | | | | Dep. at 130, 148-149 (CX-2514); Dep. at 36 (CX-1457). |
| 8 | | | | Dep. at 104-110 (CX-1413). |
| 9 | | | | |
| 10 | | | | at 47-48 (CX-2515); CX-1545; at 99 (CX-1413) |

**1.**

91.

CX-2049.

92.

CX-835 at       874 to 75; CX-823; CX-834; CX-835 at                                  859 to 863; CX-824;

CX-829;                                                                          Dep. at 66:21, 70:3, 7: :3 to

74:17, 81:17 to 83:17, 87:16 to 87:25, 106:5 to 106:12, 153:10 to 154:2 (CX-1457); CX-1983;

CX-2082.

93.

CX-

2050 at  MSC-07 000438 to 443; CX-2051, CX-2052, CX-835          874 to 75; CX-823; CX-

834; CX-835 at                859 to 863; CX-824; CX-829; CX-811;

; CX-837; CX-1557; CX-1988;                                Dep. at 66:21, 70:3, 73:23 to

74:17, 81:17 to 83:17, 87:16 to 87:25, 106:5 to 106:12, 153:10 to 154:2 (CX-1457).

94.

CX-2465.

95.

CX-823; CX-824.

96.

Dep.

at 115:17 (CX-1457).

Dep. at 130:23 to

131:8 (CX-1457).

Dep. at 136:20 (CX-1457),

CX-821; CX-824; CX-1557

at MS-0001880;                                              ; CX-1788; CX-1237 at   001525; CX-

49

825; CX-827;                    Dep. at 66:21, 114:20, 131:1, 134:2 to 136:9, 149:5 (CX-1457).

97.

.

CX-2500;                                              ; CX-814; CX-1670; CX-2251;

CX-2503;                    Dep. at 156:13 to 160:4 (CX-1457).

98.

CX-2237.

.

99.

.

CX-1958.

100.

CX-827; CX-1914 at 45; CX-839; CX-1984.

101.

.

CX-2054;          Dep. at

36:14, 66:21, 82:23 to 84:17 (CX-1457); CX-2360;      CX-2057 at MSC-07 000481, 484; CX-

2056.


102.




CX-2056.


103.                                                                                 .


CX-2049; CX-2058.


104;                          .

CX-2237.

105.

CX-1988; CX-
1812; CX-25; CX-2003; CX-1565; CX-1955.

**2.**

106.

IH at 179:22 to 179:25 (CX-2764).

.

107.

at 180:18 to 180:21 (CX-2764).

**3.**

108.    .

CX-2314; CX-301;          IH at 126:25 to 127:13, 128:8 to 136:16 (CX-

2515); White Paper at 33 (CX-1914).

a.

109.

Ex. 3 (CX-301);

(MSC) IH at 126:25 to 127:13, 128:8 to 136:16 (CX-2515); CX-1914 at 33.

110.

(CX-1416);               (MSC) IH at 126:25 to 127:13, 128:8 to 136:16 (CX-2515); CX-1642;

CX-1643; CX-465; CX-301; CX-459; CX-315); CX-316; CX-13; CX-14; CX-436; CX-463;

CX-313; CX-369; CX-365; CX-314; CX-362; CX-361; CX-357; CX-2376 at MSC-25 006201 to

28; 248 to 75.

.

111.

.

(MSC) IH at 47:1 to 47:14, 49:13 to 50:18, 133:12 to 133:14 (CX-

2515); CX-477; CX-473.                                                                      .

112.

IH at 130:21 to 138:18 (CX-2515); CX-1453; CX-321; CX-1458; CX-306; CX-469; CX-329;    Dep. (CX-1503).

**b.**

113.

CX-487; CX-441; CX-440; CX-443; CX-445; CX-442; CX-439; CX-438; CX-486; CX-434; CX-354; CX-2388.

**c.**

114.

.

CX-479; CX-429; CX-431; CX-452; CX-
2075.

115.

Dep. at 126:15 to 129:8
(CX-1416).

116.

CX-485; CX-484;
CX-428; CX-351; CX-2075.

117.

CX-34]; 　　Dep. (CX-1503).

118.

CX-2311; CX-341; 　　Dep. (CX-1503).

**d.**

119.

CX-467; CX-461; CX-456; CX-452; CX-460; CX-464; CX-466; CX-453; CX-454;    Dep. at 21:5, 39:6 to 42:9, 43:6 to 45:11 (CX-1416);    Dep. at 98:13 to 100:17 (CX-1413).

120.

CX-454; CX-464; CX-421.

121.

CX-422; CX-421; CX-333; CX-321 at    02-0015 to 0018; Dep. at 60:12 to 62:18 (CX-1416).

122.

Dep. at 62:22 to 67:22 (CX-1416).

123.

CX-422; CX-333;

CX-321 at     -02-0015 to 0018.

124.

Dep. at 70:18 to 72:18 (CX-1416).

c.

125.

CX-477; CX-473    -000125 to 26; CX-477    -000433.

4.

126. NASA, the inventor of Nastran,

CX-2453;

CX-2459; CX-1576;    IH at 140:6 to 141:7 (CX-2515); Morgan IH at 87:13 to 88:19 (CX-

1527); CX-1557 at MS-0001880;        CX-145; CX-119; CX-104; CX-105; CX-140.


127.




                                                              CX-2457; CX-2458;

        CX-2449; CX-2450; CX-2452.



                a.

128.




                                        CX-145; CX-2453;    Dep. at 197:8 to

205:25 (CX-1491).



129.

CX-2474; CX-2451; CX-2454; CX-2455.

130.

. CX-2448 at MSC-74 005374, 005379.

**b.**

131.

CX-157; CX-147; CX-148.

**c.**

132.

CX-117 at

0243 to 0251;　　　Dep. at 55:6 to 56:15, 61:3 to 61:14, 63:1 to 65:2, 67:23 to 68:8, 71:12 to 74:13 (CX-1491); CX-2432; CX-2433.

133.

Dep. at 74:15 to 78:21, 82:9 to 90:7, 92:16 to 93:10, 103:2 to 104:4 (CX-1491); CX-2456.

d.

134.

Dep. at 86:21 to 92:4, 109:12 (CX-2516); CX-2427; CX-2428.

135.

.

Dep. at 76:20 to 77:5 (CX-1416); CX-2154.

136.

Dep. at 86:21 to 92:4 (CX-2516); CX-2346; CX-2154; CX-2429.

e.

137.

Dep. at 117:6 to 119:1 (CX-1491).

138.

Dep. at 117:6 to 119:1 (CX-1491);

CX-2386 at MSC 25-006135 to 39.

5.

139.

CX-1557 at MS-0001880; CX-1140; CX-1610 at MS-0004084.

140.

. CX-1975 at MSC-02 002498.

141.

CX-1557 at MS-0001880; CX-1108; CX-1110.

142.

CX-1155; CX-1106; CX-1107; CX-1129; CX-1135.

143.

CX-1576 at MS-0002905; CX-1142; CX-1153.

144.

CX-1119.

145.

CX-1161; CX-1162; CX-1105.

**6.**

146.

CX-1576 at MS-0002905; CX-2234 at MSC-161 00157-70.

**a.**

147.

CX-1914

at 12;        IH at 45:1, 55:1 (CX-1527).

148.

149.

.

150.

CX-2080.

151.

CX-1576 at MS-0002905; CX-1608 at MS-0003855; CX-2053 at MSC-07

000444;          Dep. (CX-1496).

152.

153.

III at 84:25 to 87:12 (CX-1527);       III at

148:6 to 148:12 (CX-1418); CX-980; CX-1914 at 12, 43.

154.

155.

156.

CX-1576 at MS-0002905; CX-1587 at MS-

0003142; CX-1766 at MS-0018863; CX-1975 at MSC-02 002498; CX-2055 at MSC-07

`

0000453; CX-2080 at MSC-09 001659; CX-913 at 0000352; CX-911 at

0000345; CX-931 at 000589; CX-937 at 0000653; CX-939 at

0000667; CX-969 at 0001849; CX-2055 at

MSC-07 0000453 through 464.


157.



CX-1587 at MS-0003142.


158.


CX-980; CX-1623 at

MS-0005860.


159.



CX-1576 at MS-0002905;   CX-1608 at MS-0003855; CX-2053 at MSC-07 000444.


160.

CX-

1572 at MS-0002667; CX-1576 at MS-0002905; CX-1587 at MS-0003142; CX-2053 at MSC-07

000444; CX-2378 at MSC-25 003225; CX-907 at                              000298; CX-

919 at                              0000407; CX-929 at                    0000567; CX-939 at

                    0000667; CX-952 at                    00001038; CX-962 at

0001392; CX-953 at                    00001143; CX-967 at                    0001831; CX-

968 at                    0001835; CX-974 at                    0001938; CX-977 at

0002034.


161.


                                        CX-1135; CX-909 at

0000326; CX-955 at          0001193; CX-956 at          0001195.


162.

CX-916 at

0000361; CX-923 at 0000543; CX-934 at

000626; CX-939 at 000667; CX-944 at 0000731; CX-945

at 0000732.

163.

CX-208 at MSC-10 00162.

.

164.

.

CX-1976 at MSC-02 002560; CX-2378 at MSC-25

003225.

165.

.

CX-1956;   Dep.

(CX-2514).


**b.**

166.


CX-2257; CX-1260; CX-1261; CX-
1262; CX-1263.


**c.**

167.

.


.


CX-8.


**7.**

168.

CX-2385; CX-2380.

**8.**

     **a.**

169. The U.S. Department of Defense High Performance Computing Modernization Program's ("HPCMP") major resource center in Vicksburg, Mississippi,

CX-1914 at 14;          151 to 154 (CX-1491)

170.

DoD contracted with CSAR to develop parallel processing capability. Additionally, the U.S. Air Force contracted with UAI to develop Astros, a Nastran based-aeroelasticity product.

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     **b.**

171.

c.

172.

CX-1914 at 14.

173.

Dep. at 169:15 to 172:13, 177:10 to 180:2 (CX-1491).

**9.**

174.

Dep. at 37:1 to 37:5, 234:23 to 235:10 (CX-1457).

**10.**

175.

CX-1557

MS-0001880); CX-194 at 11-12 .

11.

176.

    Dep. at 21:3 to 21:21 (CX-2516).

**12.**

177. Hughes Satellite builds commercial satellites and military missiles for the U.S. and foreign governments. Hughes sold off several units to Raytheon in the late 1990s. Boeing eventually acquired Hughes in 2000.

178.

    Dep. at 216:5 to 216:21 (CX-1414).

179.

    Dep. at 222:11 to 222:14 (CX-1414).

**a.**

180.

Dep. at 166:20 to 167:6 (CX-1414);

CX-1306.

181.

CX-1300; CX-2307; CX-1306; CX-2402; CX-1635.

182.

.

CX-501.

**h.**

183.

.

CX-2402;        Dep. at

222:11 to 222:14 (CX-1414).

184.

CX-2279 at MSC-38 004399.

**13.**

185.

a.

186.

CX-

2103.

b.        .

187.

Dep. at 99:9 to 22, 193:10 to 197:23 (CX-1413).

**14.**

188.

CX-1578; CX-2381.

**15.**

189.

CX-2155.

**16.**

190.

CX-1981 at MSC-02 003918.

**17.**

191.

192.

CX-1010 at    000114.

193.

Dep. 115:4 to 115:23 (CX-1414)

194.

CX-1003 at     000051. *See also* CX-1002 at     000042; CX-1016 at     0001387.

195.

CX-1012 at    000541.

196.

Dep. 115:4 to 115:23 (CX-1414).

Dep. at 109:17 to 111:22, 117:11 to 118:6 (CX-1414);

**18.**

197.

Dep. at 105:4 to

105:10 (CX-1413);       IH at 127:25 to128:7 (CX-2515); CX-1832 at MS-0036309

to 310; CX-1833; CX-1583;     Dep. (CX-1503).

198.

Dep. (CX-1503).

**20.**

199.

Dep at 98:10 to16 (CX-2514).

200.

Ex. 9 at   000122 (CX-1214); CX-1216 at   000135.

201.

CX-1233; CX-2077.

83

202.

MS-0006672-3;                IH at 190:15 (CX-2515);                IH at 213:19 to 215:5

(CX-1418); CX-13; CX-16; CX-1557 at MS-0001911 to 12; CX-1237; CX-1233;

Dep. at 369:4 to 369:14 (CX-1496).

203.

CX-1237.

204.

.

CX-1237.

205.

.

CX-1242.

206.

.

.

CX-1636 at MS-0008413 to 15;  CX-16 at MS-0008495.

207.

CX-1558 at MS-0001911; CX-1235 at  001509; CX-1234.

208.

CX-1224 at  000801; CX-1233;

Dep. at 52:6 to 53:1, 53:2 to 53:15 (CX-1518);                    IH at 113:2

to116:18 (CX-1527); CX-1224; CX-1233; CX-1235; CX-1238;

Dep. (CX-1496).


209.


CX-1232.


210.


                                                                    CX-2024;

Dep. 105:17 to 105:18 (CX-1509).

211.

CX-1231 at

001135, 1144.

212.

CX-1240 at      002172; CX-

1210 at   000080.

.

213.

.

CX-2023 at MSC-04 000308;

Dep. 184:4 to 184:18 (CX-1509); CX-2331.

214.

CX-1226 at 001060 to 61.

215.

CX-2292.

216.

CX-1208 at   000044 to 50;

Dep. 237:2-6 (CX-2514);                              Dep. 211:25 to 212:6 (CX-

1509); CX-1218 at   000258.

217.

Dep. 204:18-24 (CX-1509); CX-1216

at   000136.

218.

Dep. at 146 (CX-2514).

219.

to 242:17 (CX-2514);                                Dep. at 68:9-23, 70:6-22, 189:6-

11.192:4-7 (CX-1509).

220.

. CX-1956;    D  .

(CX-2514).

**21.**

221.

IH at 45:17 to

46:22, 125:17 to 126:7, 230:25 to 231:5 (CX-2515);                  IH at 58:20 to

59:18, 87:5 to 87:12, 201:14 to 201:19, 203:4 to 203:9 (CX-1527);          (CX-1496);

CX-1914 at 43; CX-1237 at  001593;       Dep. at 301:12 to 305:2 (CX-1417); CX-2323;

Dep. at 106:12 to 106:17, 107:24 to 109:4 (CX-1503).

222.

Dep. at

239:15 to 239:21 (CX-1504); CX-2389; CX-2390;        Dep. (CX-1414).


223.


Dep. at 237:7 to 237:15 (CX-1504).


224.


CX-1062 at        at 006035; CX-2394;        Dep. (CX-1414).


**22.**

225.

IH at 19 to 20, 27, 77 to 78, 84 to 85,

146, 150, 210, 212;        IH at 88-90, 150-151, 265-266; CX-1914 at 39; MS-0002529; MSC-

140 003319 through 20; MSC-154 002135; CX-562; CX-508; CX-516 at D9299        000654;

226.

227.

Tr. 89:25 through 90:23;        Tr. 101:22 through 102:24; CX-

578 at    002124; CX-561; CX-578 at    002124.

228.

229.

Tr. 43:13 through 44:16, 45:5 through 10, 46:3-25, 106:12 through 107:8.


230.




231.




MSC-138 007860.


232.


.

233.

MS-0003058; CX-616; CX-617;

CX-618; CX-619; CX-620; CX-621; CX-622; CX-623; CX-624; CX-625; CX-626; CX-627;

CX-630; CX-632; CX-633; CX-634; CX-637; CX-638; CX-640; CX-641; CX-642; CX-643;

CX-644; CX-645; CX-646; CX-647; CX-649; CX-650; CX-651; CX-654.

234.

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235.

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MS-0017869 through MS-0017874, at MS-0017870. (

; CX-516;                              Tr. 52:1 through 55:20; 57:16

through 59:20, 60:4-6;     000235.

236.

CX-516;

CX 523.

237.  MSC has maintain price differences in the past between customers.

CX-2292 (MSC -18 019092 to 94).

238.

MSC-160-

000639; D9299    013160-62;  D9299    000231

239.

.

.

CX-523

240.

IH at 19 to 20, 27, 77 to 78, 84 to 85, 146, 150, 210, 212,

152-54;          IH at 88-90, 150 to 51, 265 to 66;          Dep. at 116 to 118; CX-1914 at 39;

MS0001389 to 1390; MSC-154 002140-46; CX-571; CX-508;          000348;          000896;

CX-573; CX-682; CX-683.

241.

MS-0001390; MS0001389 to 13090; CX-508;

242.

Tr. 181 to 182, 122:3-21; MS-0002383; CX-508;

243.

Tr. at
169 to 170;    009792; MSC-02 00267; CX-574.

**22.**

244.

CX-2073 at MSC-09 00688.

23.

245.

246.

CX-876
at 36001-    -0574 to 576; CX-886; CX-885.

247.

CX-853 at 36001-    -0005; CX-854 at 36001-    -0014 to 23; CX-858 at 36001-                -
0043 to 47.

248.

.    CX-2462 at MSC-74 021988 to 89; CX-
2463 at MSC-74 022139.

**24.**

249.


IH at 74:1 to 77:19 (CX-1418);

Dep. at 299:3 to 301:2 (CX-1417);                    Dep. Ex. 31 (CX-2323); CX-1914 at 11-12,

43;                    Dep. at 191:12 to 192:6 (CX-1496).


**25.**

250.

CX-2084 at MSC-09-001978 to 79.


**26.**

251.


CX-1813 at MS-0006571 to 76; CX-2351 at MSC-22 003722.


**27.**


252.

253.

CX-1026 at     0237; CX-1025 at     0234.

254.

CX-1023 at    0105; CX-1024 at    0168.

255.

Dep. (CX-1413).

**D.    Switching Between Advanced Nastrans Was Relatively Easy**

    **1.    Common Origin and Source Code**

256.  The switching costs when substituting UAI or CSA Nastran for MSC Nastran are not substantial because the Nastran codes have common architecture, having all originated from the same public domain NASA code.  Users that have switched between the advanced Nastran programs generally have found the cost to be minimal.                        IH at 239-40 (CX-1527);            (MSC) IH at 117 (CX-1418);            IH at 176 (CX-1505); CX-21 at 2332; Anticipated testimony of

257.  MSC Nastran, UAI Nastran, and CSAR Nastran are functionally interchangeable to a high degree.                                            Switching among

advanced Nastran solvers does not involve substantial switching costs because all of the advanced versions of Nastran derive from the same NASA Nastran source code, generally solve the same types and sizes of problems, use the same input and output file formats, and offer the same or similar element libraries and graphical user interfaces. All three offer DMAP, a programming language and functionality allowing the user to modify and customize the analysis results. Several Nastran users have conducted comparative benchmark studies which show that the three advanced versions of Nastran all offer the same or similar capabilities and are closely interchangeable. TH at 82, 118; 124; 162; 166-67 254, 272 (CX-1418); (MSC) Dep. 117; CX-14 at 2029; TH at 40, 242-43, 258; TH at 164 to 165 (CX-1505); CX-5 at 4194; CX-1 at MS-0000699; Dep. at 98-99 (   ); CX-1788 at MS-0026668; CX-464. Anticipated testimony

258. UAI and CSAR were close competitors to MSC's NASTRAN in part because it was relatively easy for customers to switch. The cost of learning UAI and CSAR Nastran to replace MSC Nastran is drastically reduced compared to the cost of learning a new FEA code. CX-21 at MS-002332; CX-454 at    -000100; TH  118 to 119

(CX-1527). Anticipated testimony

104

259.

IH at 40, 242-43, 258.

260.

CX-2625 at Ansys 07038 to 7039; CX-

2553 at    0174.

2.    Maintaining Compatibility

261.

CX-2767 at

105

00017; CX-1581 at MS-0003003-05.

262.

CX-2 at MS-0000743

263.

CX-5 at MS-0004194

264.

CX-2083 at MSC-09 001957; CX-1870 at MS-0003250;

IH at 117 (CX-1527).

265.

IH at 129-30, 135, 141-42 (CX-1527);

IH at 108-11 (CX-2764).

266.

129-30, 135, 141-42 (CX-1527);

IH at 108-11) (CX-2764).

267.

CX-1610 at MS-0004097; 04153-B, pages

1 and 2

268.

269. The Air Force Research Laboratory at Wright Patterson Air Force Base often used CSA NASTRAN for large model analysis and got the same answers for the same problem on MSC NASTRAN at the MSRC. Air Force researchers at AFRL had such confidence in CSA NASTRAN's linear statics and dynamics capabilities that, when shown the results of a problem run, noone would ask whether it was done on CSA or MSC. Anticipated testimony of Dr. Venkayya (US Air Force, retired)

### 3.    Benchmark Comparisons Substantiate Close Functional Interchangeability Between Three Advanced Nastrans

270. In making purchase decisions, a common practice in the field of structural engineering is to evaluate the performance of finite element solvers by running a set of benchmark test problems. In addition, this practice enables the user to determine the important features and capabilities of the solvers. The results of the analysis, the speed of the computation and the use of computer resources are the measures of performance. Anticipated testimony of Dr. Venkayya.

271.

(MSC) Tr. 151 to

154 (CX-1491); Anticipated testimony of Dr. Venkayya,

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272.

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CX-302 at   -0000016,   -0000025 &   -0000028; CX-356 at

109

-09-0176.

273.      .

CX-301

274.

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CX-1009 at     000091, 000094, 000104-05, 000107 000111-14.

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275.      .                    .

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CX 120

276.

CX-1224 at   000764 to 806; CX-1225; CX-

1233 at   001364;                                    Dep. 52:6  to 53:15;

IH 113-15 (CX-1527).

277.

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CX-616 at        007901 to

911

**E.    Users View Other Nastran Solvers As Lacking Functionality to Be Close**

**Substitutes for Advanced Nastrans**

278.  Limited-featured Nastran solvers offer reduced power, fewer features, capabilities,

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and add-on speciality modules, and less flexibility than MSC Nastran. They generally are used by design engineers and not professional analysts. Design engineers generally work on a PC Windows platform, solve less complex problems than professional analysts, and need greater ease of use.

Dep. 76 to 78, 84 to 87, 110; IH 51:11 to 52:4, 85, 228, 237-38 (CX-1418); Dep. 97 to 99, 176 to 181; Dep. 256 to 257; CX-1629 at 7007; Tr. at 256 to 57 (CX-1505); CX-683 at 009790; CX-470 at -000019; CX-2475 at MSC-74 025526 to 25527. Anticipated testimony of Dr. Venkayya.

279. The original NASA-funded NASTRAN software was made available to the public beginning in the 1970's via the Computer Software Management Information Center (COSMIC) at the University of Georgia. COSMIC NASTRAN is not a substitute for MSC NASTRAN for users of MSC NASTRAN. Although all NASTRANs have their roots in COSMIC NASTRAN, it did not keep up with the development of features and enhancements over the course of the last 12 years. The element library in COSMIC NASTRAN is not as comprehensive in the NASTRANs offered by CSAR, UAI and MSC. Among the line elements, it does not have the

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BEAM and BEND elements. The BEAM element is a very versatile element. Its absence in COSMIC NASTRAN constitutes a major deficiency in the sense that it restricts modeling freedom. Among the surface elements missing from COSMIC Nastran are the TRIAG, QUAD8, TRIAR and the QUADR. Higher order solid elements are also missing. Among the scalar elements the BUSH element is missing. Moreover, COSMIC NASTRAN's solution schemes are about 30 years old. CSA, UAI and MSC NASTRANs can all solve very large structural analysis problems 10 times faster than COSMIC NASTRAN. The three commercial NASTRANs made significant enhancements to their MPYADD (Matrix Multiply Add) routines and have all adopted/implemented the Boeing Computer Services version of the Block Lanczos eigensolver. There were numerous other enhancements made in the commercial NASTRANs not found in COSMIC Nastran. Anticipated testimony of Dr. Venkayya;

IH 14:17 to 15:18 (CX-2764); IH 25:9 to 29:8, 30:13 to 31:4, 32:3 to 33:15 (CX-1527).

280. Given the foregoing deficiencies in COSMIC NASTRAN, it would not be technically feasible for any company to start now with the publicly available version of NASTRAN, and develop a commercially acceptable version of NASTRAN within the next two to five years.

This is not simply a matter of throwing resources at the problem. Much FEA solver development work must proceed sequentially, and cannot be done in parallel. Doubling the size of the development staff will not double the rate at

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which the software can be upgraded. Anticipated testimony of Dr. Venkayya. CX-2 at MS-0008634; IH 225:1-23 (CX-1505).

281. MI NASTRAN is distributed by a company called Macro Industries. Macro Industries has been in existence for many years but                              MI NASTRAN is not a substitute for MSC NASTRAN. MI Nastran offers few improvements over NASA's public domain version of Nastran.

CX-116 at 45001-          -0236 - 237; CX-117 at                    -
0238 - 242;          -000716-17; CX-114 at            -0233.

282. Noran Engineerings's NE Nastran is not a Nastran at all. It is not based upon the NASA public domain Nastran code. NE Nastran is available only for the PC platform and it lacks substructuring and DMAP capabilities. CX-2639 at          11403-04. It also has a different element formulation, which means that legacy MSC Nastran models that are run on NE Nastran will give different results than they would using MSC Nastran. CX-2639 at 11404; CX-2473 at MSC-74 024458; CX-2154 at MSC-154-002720 to 21; CX-1511 at MSC-54-

2951.

## IV. Advanced Nastran Users Are Unlikely to Switch Away From Advanced Nastrans in Response to a Small but Significant Nontransitory Increase in Price

### A. High Switching Costs Discouraged Substitution of Non-Nastran Solvers for Advanced Nastrans

283.  Switching away from MSC, UAI, or CSAR NASTRAN to another solver by a

company employing professional analyst is difficult and costly.  Users have  projected significant

switching costs in switching between Nastran and non-Nastran solvers.

Anticipated testimony of

; CX-2417 (Perna (July 23, 2001, report to Wall Street on 2$^{nd}$ Quarter 2001));  CX-2365 at MSC-22 004827.

284.  There is natural resistence or inertia among engineers to change solvers because of

their familiarity with and confidence in the performance of a particular solver.  CX-1914, White

Paper at 30 n. 125; CX-20; CX-21;                    IH at 136-37 (CX-1527).  Anticipated testimony

285.

Dep. 159:19 to 160:21,162:19-25.

286.

CX-1904,

CX-2365 at MSC-22 004827.     Anticipated testimony

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## 1.     Training Costs

287.  Any switch of solvers involves training costs and the time needed to become

proficient with the new solver.  FEA solvers are complex tools and involve different interfaces,

commands, input and output file formats, and programming languages and sequences.  Thus,

training is needed to learn how to use the new solver, to understand its features and capabilities,

and to be able to interpret its analysis results.  These costs can include tuition costs, travel costs,

and lost productivity from employees attending the training class.  The training costs associated

with switching from NASTRAN to other solvers can be large.  Attending a week or two training

course does not produce a savvy user.  It takes months or even years to understand the modeling

nuances of different programs.  Subtle differences, structural element formulations, material

models,

boundary conditions interpretation and element property definitions can add to the training

effort.                    IH at 216-17, 229.  Anticipated testimony of Dr. Venkayya,


288.



CX-565 at     000348


### 2.    Reduced Productivity

289.  In addition to the time and costs associated with training, the average company

analyst and engineer ⸱⸱⸱ ⸱s substantial hands-on experience using a particular solver to gain

proficiency in its use.


D ep. at  86:15 to 87:25.  Anticipated testimony of Dr.

Venkayya,

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290. Significant productivity losses can be expected during the transition from the old solver to a replacement solver.

CX-319 at        -01-0010

### 3.    Benchmarking a New Program - Confidence in the Results

291. Extensive validation and verification of the new solver program is critical and must be done before a company can accept its results. Benchmark problems for testing must be representative of the custo ~r's most frequently used applications. Lack of familiarity with modeling techniques of a new program, and how the elements, boundary conditions and loading conditions differ from the previous program can lead to failure of the product. The associated liability costs can outweigh the software costs. Anticipated testimony of Dr. Venkayya,

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### 4.    Legacy Models and Data

292. Users of FEA solvers often need to reuse old input and output files and models or compare prior files and models with new files and models. These existing or older input and output files and modes are known as "legacy files." When switching to a new FEA solvers, a user often needs to convert such legacy files to a format used with the new solver. Each solver accepts a different input file format and uses different element libraries and codes. Thus, a new

solver cannot perform an analysis on the legacy model until it has been converted to an input file format acceptable to the new solver. After a legacy model has been rewritten for another solver, any comparison between the existing and proposed new design will likely require analyzing the rewritten legacy model in the new solver because analysis results cannot be compared accurately unless run through the same solver. Legacy models which have proven successful by repeated use and have been verified by physical testing are an additional deterrent to switching solvers.

IH at 64 (CX-1527);                                    IH at 68-69, 288 (CX-1418);

IH at 217-18, 229;                                     Dep. at 66:10 to 68:5.

Anticipated testimony

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293. Legacy issues are particularly important in the aerospace industry where aircraft or satellites have long life spans and comparisons are conducted over the life of the structure or model series.


A new airplane, built for the Air Force, stays in service for over 20 to 30 years. During its life the airplane undergoes many modifications. New battle scenarios, insertion of new technology, new armament requirements are the reasons for the modifications. Legacy models play a critical role in the re-certification of the flight worthiness of the modified system. This task becomes difficult if the legacy models are not compatible with the new solver. The time and costs to rewrite these

models is substantial.

CX-14 at 2003;                    IH at 261-62 (CX-1418);

IH at 229; CX-2365 at MSC-22-004827.  Anticipated testimony of Dr. Venkayya.

294.  The cost of converting legacy files and models between advanced versions of Nastran

is much less than when switching from a Nastran solver to a non-Nastran solver.  The UAI, CSA

ad MSC Nastran solvers all use generally the same input and output file formats, element

libraries, and source code.                    IH at 87, 112-13, 158 (CX-1527);        IH at

82-83, 118; 124; 162; 272 (CX· 418); CX-14 at 2029;                    IH at 40, 242-43, 258;

IH at 164 (CX-1505);  CX-5 at MS-0004194; CX-1 at MS-0000699;

IH at 129-30, 135, 141-42 (CX-1527);                    IH at

108-11 (CX-2764).

295.  There is a substantial cost of converting legacy files when substituting a non-Nastran

solver for a Nastran solver.  The substantial volume of data contained in an FEA model makes

the conversion costly, particularly for complex structures.  Moreover, unless there is one-to-one

correspondence between the capabilities of the Nastran solver and the new solver, the legacy

model may not work.  For example, a model created for MSC Nastran may use an element that is

unique to MSC's Nastran element library.  When the model is converted for use with ANSYS or

another code lacking an element to satisfactorily emulate the original Nastran element, the

mathematical results from the translated ANSYS model will differ from the Nastran model's

results.  When this

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occurs, an engineer must modify the converted model until he or she is satisfied that the results from the converted model are sufficiently close to the results of the original model. In addition to variations among the elements, each solver's distinct treatment of boundary conditions, loading conditions and even implementation of the solution sequences can also lead to incompatibilities and different results.      IH 286-89 (CX-1418). Anticipated testimony of

Dr. Venkayya.


### 5.    Network Use of Advanced Nastran

296. NASTRAN is used widely for linear structural analysis in the aerospace and automotive industries. The majo   utomakers and airframe integrators commonly use outside suppliers. Use in common of the Nastran solver facilitates exchange of data among the automakers and their suppliers and the prime airframe integrators and their subcontractors. In both cases the primary manufacturer and their suppliers frequently share analysis models and results. Indeed, one of the reasons that NASA originally sponsored the development of NASTRAN was to create a common tool for sharing analysis information among its suppliers. Airframers value data compatibility and compatibility with their customers and suppliers. This extensive collaboration discourages any one firm from switching away from NASTRAN. Likewise, nearly all major automobile makers (OEMs) in the world use Nastran for structural analysis.

Anticipated testimony of Dr. Venkayya,

IH at 71-72 (CX-1527); CX-1554                                   IH

at 250-51 (CX-1418);  CX-2155 at MSC-149 03226 to 27; CX-15, MSC-02 002275; CX-1260 at

00004;                                                    IH at 85-88.

(CX-

2764).

297.

CX-13 at MSC-06 000126, 0129; CX-1176 at 35001-    000068-69; CX-1895 at

MS-0009650-51, 9655.  Anticipated testimony

298. There are some government and commercial contracts that explicitly require the use of Nastran to capture the benefits of these network externalities.

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CX-1554; CX-305 at

IH at 86, 273

(CX-1418); CX-876 at 36001-  -0574-76;CX-1405, MSC's Response to CID Para. 12; CX-2295 at MSC-18 018821 to 23; CX-781; CX-782; CX-783; CX-130 at                - 0115 to 165

; CX-522 at

001357.

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300. Companies and government agencies that have not expressly required Nastran data in their project contracts nonetheless recommend or otherwise induce their suppliers to use Nastran.

IH at 250-51 , 271-72 (CX-1418); CX-1338

CX-1339 at 0000033-40 ; CX-1027 at

1590. Anticipated testimony

### 6. Nastran and Certifying Agencies

301. NASTRAN is the solver wid ly used by the aerospace industry. Certifying agencies, such as the FAA, do not have adequate resources, time or manpower to become familiar with all the solvers. Although the agency does not mandate the use of NASTRAN or any other solver, its job becomes easier if the certifying criteria are presented in the context of NASTRAN results. Thus, it is unwise to switch to another solver unless FAA or another certifying agency has familiarity with the code. Anticipated testimony of Dr. Venkayya. CX-13 at MSC 06 000116 to 0118; IH at 89:11 to 91:4 (CX-1418).

### 7. Complementary Software

302. Switching between two FEA solvers may require changing complementary software to be compatible with the new solver and involve the substantial loss of a customer's investment in such complementary software. Nastran users often make substantial investments in software

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commands and applications that conduct further analysis of Nastran output data. Nastran, for example, offers its own unique programmable code known as DMAP that permits the user to better manipulate the Nastran analysis output information. MSC also offers a series of applications that operate with Nastran such as Akusmod (automobile interior noise and acoustic analysis) and Flight Loads and Dynamics (advanced aerospace analysis). Several third parties also supply applications that conduct further analysis of Nastran output such as LMS and Mechanical Dynamics Inc. (now owned by MSC). Moreover, users develop other in-house software to work with or incorporate into Nastran. In those cases, Nastran becomes part of the user's processes. The investment in this complementary software would be lost if a Nastran user switched to another solver..

CX-1203 at 440-41; CX-1896 (MSC Price List (7/28/00); CX-1834,

; CX-1835, (Dec. 1999);

Dep. at 299-301 (CX-1417); Ex. 31 MSC-18 032833 through 36;

Dep 38:20 to 41:19 (CX-2514); CX-1260 at 00004; CX-

2553 at 0175.

8. **Pre- and Post-Processors, Translators, and Industry Standards Lack Precision To Make Substitution Practical**

303. So called "translators" are commonly built into many commercial pre- and post-processors. While translators facilitate the conversion of the geometric data of a finite element model, they cannot completely and accurately translate all information. There is some information, particularly in more complex models, that cannot be converted easily. Such information typically will be lost, requiring hands-on clean up. The data that is not translatable can be critical and can alter the simulation results. For example, even if the geometry is correct, models break down unless the boundary conditions, loads, and material data are correct. Finally, different solvers' implementation of the solution sequences can also lead to incompatibilities and different results. Analysts cannot rely on translators without fully understanding how both the new and old solvers treated the same problem and model.    IH at 285-86 (CX-1418); IH at 217-18; CX-1914 at White Paper at 31, 32;    Dep. 35:19 to 37:15; 117:25 to 118:23. Anticipated testimony of    , Dr. Venkayya.

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304. Translators are unable to translate special codes or functionality such as Nastran's DMAP, the programmable language to extract specialized data from a Nastran analysis. DMAP is unique to Nastran and customers with legacy DMAP programs will incur substantial reprogramming costs when switching to another solver. ANSYS uses its own command language known as APDL (ANSYS's parametric definition language). Indeed, in some cases, DMAP programs may not even be translatable.    IH at 258, 289-90 (CX-1418); )    IH at 227-29.

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305.

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CX-2605 at      00825 to 839;    CX-2636 at       11331; CX-2640 at      11409.


306.  A consortium of users and engineering software suppliers, including      , are

currently developing a new international standard format for finite element data known as

AP209.  Its purpose is reportedly to facilitate moving models and input and output files between

different solvers.  The standard will allow the same FEA model to be analyzed across a range of

solvers, provided the solvers have matching capabilities.  However, this work has been going on

since before 1995, and the standard is still in draft form.

TH at

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81-83, 119-22, 125, 277- 90 (CX-1418); CX-14; CX-2328;                                    IH at

236-38 (CX-1527); CX-1858; CX-1859; CX-1860; CX-1861; CX-1618 at 4694;

IH at 153, 257-58.


### 9. Partial Substitution Does Not Significantly Reduce the Cost of Switching


307. Nastran is a general purpose solver. Its ability to analyze a broad range of engineering problems within one solver reduces the number of different solvers a user may need. The use of a single general purpose solver offers a number of benefits to companies over combining the functionalities of numerous niche solvers. These advantages include lower training costs, the ability to share models among different groups within the organization without having to create new models for each analysis type, and lower transaction/administration costs (dealing with fewer vendors and fewer contract renewals). Moreover, there is a "symphonic effect" in employing a general purpose solver, in that the combination of analyses types performed together is validated. Indeed, with more users, the commonalities across analysis types are validated to a greater extent and enhance user familiarity with the same elements and boundary and loading conditions (which could be used in various analysis types) and increase user confidence in their performance. Indeed, optimization or coupled analysis in which constraints come from different disciplines can be done by a general purpose solver that offers solutions in all such disciplines, but may be impossible to perform with a mix multiple niche solvers. Moreover, having engineers trained and

proficient on a general purpose solver gives a company greater flexibility in deploying engineers since engineers may move from project to project, which pose different problems requiring different analysis types, throughout their careers.

CX-1895 at MS-0009648-9677; IH at 63-64 (CX-1527); IH at 33-39 (CX-2764); Dep at 137:19 to 138:13. Anticipated testimony of Dr. Venkayya.

## B. Professional Analysts Do Not View Other Solvers As Close Substitutes for Advanced Nastran

### 1. ANSYS

#### a. ANSYS Background

308. ANSYS is a publicly-traded engineering software supplier that sells a line of FEA solvers generally under the name ANSYS.

ANSYS offers different solvers for the analyst market and the designer market. Its high-end solvers are (1) ANSYS/Multiphysics, a sophisticated multi-disciplinary computer-aided engineering tool

; and (2) Ansys/Mechanical, a solver designed to compute structural and thermal analyses. For the designer market, ANSYS offers a product called DesignSpace with a list price of

The  following chart shows Ansys's total revenues and revenues for Multiphysics and Mechanical from 1997 to 2001:

| Year | Revenue for Ansys Multiphysics and Mechanical | Total Revenue |
|---|---|---|
| 1997 | | |
| 1998 | | |
| 1999 | | |
| 2000 | | |
| 2001 | | |

http://www.ansys.com/ansys/mechanical.htm;


http://www.ansys.com/newsrooms/annual_reports/2001_annual.pdf.


309.  Most automotive and aerospace companies have NASTRAN plus ANSYS or
ABAQUS (or both), because these other codes have specialties that are different from
NASTRAN.  NASTRAN is the mainstay for linear and quasi-linear analysis.  In contrast,
automotive and aerospace companies use ANSYS or ABAQUS for predicting highly nonlinear
behavior at local levels.  They are commonly used in the analysis of engines, turbines, helicopter
blades and

transmissions. In the analysis of these structures the effect of heat and rotation are important. The analysis of an engine or turbine blade is more of a local than a global analysis issue and where thermal and nonlinear effects dominate. This does not suggest that ANSYS or ABAQUS are suitable as substitutes for NASTRAN in analyzing airframes or car bodies, they are not. Anticipated testimony of Dr. Venkayya. IH at 234 (CX-1527);

IH 35, 225-27; Dep. 48 to 54; IH at 176 (CX-1505); CX-13 at MSC-06 000126.


310. Ansys and Nastran have different heritages. Ansys was originally developed for the nuclear industry, while Nastran was developed by NASA f. the aerospace industry.


### b. Marketplace Perceptions of ANSYS

311. Although ANSYS has various advanced linear structural analysis capabilities,

ANSYS lacks some basic capabilities and functionalities required by Nastran users. For example, ANSYS is not able to handle models of large complex structures and is not as fast nor as powerful as Nastran in conducting dynamic analysis. ANSYS

does not offer aeroclasticity or other features that are used throughout the aerospace industry.

This is due to Ansys's unique functionality in thermal analysis and analyzing rotating machinery, such as turbines. Anticipated testimony of

. CX-2631 at        09122 to 9124; CX-2623 at        06985; CX-19 at 1515; CX-14 at 2020, 2026, 2029;        CX 1914, White Paper at 29; IH at 54, 79-80, 85-94, 228, 237-38;

(CX-1418);                IH at 176, 256-57 (CX-1505);

IH at 35, 214, 225-26; CX-1834                ). Anticipated testimony

312. There are a number of specific features, functions, and capabilities of NASTRAN that are important to NASTRAN users that are lacking in ANSYS. For example, although the ANSYS element library is extensive, the elements themselves are not versatile as those in NASTRAN. A beam element in NASTRAN can replace 4 or 5 such elements in ANSYS. Similarly, a Nastran QUAD4 can substitute for more than one surface element in ANSYS. The multiplicity of ANSYS elements can create confusion in users accustomed to the Nastran elements.

Nonstructural masses are masses that are added to a structure but are not intended to support the structure itself (e.g., passengers ).

NASTRAN allows for the input of nonstructural masses and is commonly used to analyze the foregoing types of problems. NASTRAN also allows the definition of dynamic reduction,

optimization capabilities that MSC Nastran possesses, including the ability to perform optimization involving hundreds of variables. CX-2658 at 14248, 14251, 14256, 14258, 14314; CX-366 at       -01-0581,       -01-0590. Anticipated testimony of Dr. Venkayya.

313.  ANSYS does not have capabilities comparable to DMAP in NASTRAN, which allow users to modify the analysis types, solution sequences, data reporting and other aspects of NASTRAN.

The DMAP capabilities in Nastran are extremely important to many Nastran users.    CX-2658 at      14237

III 257 (CX-1418).

Anticipated testimony

314.

CX-1176 at 35001-    000069

315.

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CX-1552 at MS-

0001390

316.

CX-302 (      Ex. 10); CX-470 at     000017-20.

317.

CX-2609 at     03255 to 256; CX-2637 at     11339; CX-2619 at    05596 to 597.

318.

CX-2652 at

135

14069 to 14070; CX-2633 at        09231.

### c. MSC's Views of ANSYS

319.

CX-19 at MS-0001515;                   IH at 71-72, 128, 214-15, 239, 252 (CX-1418);

CX-1623 at MS-0005858-60;              IH at 219 - 200; CX-1883 at MS0-0006571-76;

CX-1834 (                              ); CX-1549 at MS-0001225-26; CX-1568 at MS-

0002431-35.

320.

IH at 51,

225-26, 228, 237 (CX-1418).

321.

CX-19 at MS-0001515; CX-1854 at MS-0002026;

IH 51, 54-55, 79-80, 85, 237 (CX-1418);                    IH 256-57 (CX-1505);

IH 35 (CX-2515); CX-2645 at          11629 to 630;          Dep. 175-176

(CX 1413);      CX-1834

322.

CX-1629

at 7007;          at 51:11 to 52:4, 85, 228, 237 (CX-1418);          Tr. at 256 to 57 (CX-

1505); CX-683 at MSC          009790; CX-470 at       -000019.

323.

CX-1549 at 1229; CX-19 at MS-0001515; CX-14 at 2029-30; CX-2359 at MSC-22 004320 to

4331;　　CX-2358 at MSC-22 004317 to 4319; CX-2355 at MSC-22 004075 to 4086;

(MSC) IH at 85, 237-38

　　　(CX-1418);　　　　　　IH at 232-35, 246-250 (CX-1527); CX-

2408 at MSC-48 003993 to 3996;

324.

CX-2365 at MSC-22 004827;

Depo at 37:20 to 38:5, 63:1 to 65:25 (CX-1457)

2.　Elfini

325.

CX-1894 at MS-0009581-82;

CX-1844 at MS-0001595; CX-1914, White Paper at 22;    IH at 152-53 (CX-

2515);CX-576 at    946

326.  On April 24, 2001, MSC announced a "strategic alliance" with Dassault

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. CX-2689: CX-2700.

327.

IH at 153-54 (CX-2515);                    III at 89-90, 240-41, 265

(CX-1418); CX-1914, White Paper at 39; IH at 177 (CX-1505).

328.

IH 66 to 67 (CX-1418);

III at 154 to 55; CX-1618 at MS-0004694.

329.

CX-470 at        -000017-20; CX-370 at        -01-1247 to 53; CX-302 at

0000012, 0022, 0029.

330.

CX-508 at    000346-48

331.

CX-508 at 000348; CX-571

at 000896; CX-575 at 000946.


332.


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IH at 66-

67, 126 (CX-1418); CX-571 000890, 0893.


### 2.   Abaqus

333.  Hibbitt, Karlsson, and Sorenson ("HKS") is a privately-held firm that distributes

computer aided engineering software, including Abaqus Standard (Abaqus).


CX-2551; CX-2552; CX-2584 at 0741-42.

334. NASTRAN is a general purpose solver offering primarily linear analysis. MSC and others in the industry have viewed ABAQUS as primarily a non-linear solver. As such, its application is generally limited to local areas where failure initiation may start. Examples of non-linear analysis tasks where ABAQUS makes the most sense include analyses involving materials such as plastics and rubber.

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CX-19 at MS-00001520; IH 56 to 57, 68, 94 to 95 (CX-1418); IH 35 (CX-1505); CX-1895 at MS-0009650; Dep. 122 to 123 (CX-1520); III 35 to 36 (CX-2515); CX-1567 at MS-002384; Dep 46, 154 (CX-2514); CX-13 at MSC-06 000126. Anticipated testimony of Dr. Venkayya

335.

MSC and Nastran users tend to view Abaqus as a complementary solver to Nastran rather than as a competing substitute solver. MSC even resold Abaqus along side Nastran in its portfolio until MSC added a robust non-linear solver to its portfolio with the acquisition of Marc in 1999. Because Abaqus and Nastran are complementary

solvers offering different capabilities, the two codes are both used by many of the same

customers but for different analyses.

CX-1854 at MS-0002026-27; IH at 40
(CX-2515); CX-19 at MS-0001520; IH at 56-57, 68, 94-95 (CX-1418);
IH at 35 (CX-1505); CX-2472 at MSC-74 024382 to 24388; CX-2460 at
MSC-74 021244 to 21245; CX-412 at MSC-53 000170.

336.

CX-2286 at MSC-18 004056.

337.

144

338. The finite elements in ABAQUS are designed for static nonlinear analysis. It has a number of higher order elements. Although they pred  t the static response in local areas well, they are not as reliable when used in combination with other types of elements. Even more troublesome with these elements is their poor performance when large concentrated masses are attached at discrete points of the structure. Aircraft fly with a number of stores under their wings, fuselage, etc. These attachments represent missiles, bombs, engines, fuel tanks, etc. In this case, dynamic analysis is extremely critical. The higher order elements of ABAQUS do not perform well. Anticipated testimony of Dr. Venkayya

339.

145

CX-2581 at
0658; CX-2561 at    0609; CX-2554 at    0191, 0195, 0205-07; CX-2585 at
0148.                            -:.

4.    Limited Feature and Specialized Solvers

340.

IH at 51, 129, 226-28, 236-37 (CX-1418);

IH at 136-37, 162-65 (CX-1527);  CX-1640 (MSC Ex. 20); CX-

19 at MS-0001514;                    III at 186 (CX-1505);            III at 138 (CX-1526);

IH at 108-09, 162 (CX-276   ; CX-1533 at 0245, 0249, 0252-53;

CX-1940 at 0422-23, 0432, 0439-40; CX-1914, White Paper at 45; CX-1331;

CX-1337 at 0021.

Anticipated testimony of Dr. Venkayya

341.

IH 51, 92 to 95, 210, 228, 236, 285 to 286 (CX-1418); III 223 to 24 (CX-2525); CX-1339 at 000028 to 40; III at 138 (CX-1526); IH 162-63 (CX-1527); CX-14 at MS-0002018, 2026, 2031, 2033 2035; CX-19 at MS-0001523 -25; CX-1855; IH 110, 140, 186, 206, 228, 256 to 260 (CX-1505); IH 108 to 09, 162 (CX-2764); CX-1914, MSC White Paper at 12 to 14, 17, 19, 24 to 25, 45; CX-1569 at MS-0002529; CX-1640 at MS-0008622; CX-1549 at MS-0001226; CX-15 at MSC-02 002252, 2267; CX-1623; CX-1857 at MS-0002352; CX-1556; CX-1640 at MS-0008622.

342.

.

Dep. 76 to 78, 84 to 87, 110

(1492);          IH 237-38 (CX-1418);          Dep. 97 to 99, 176 to 181 (CX-1520);          256 to 257 (CX-1509). Anticipated testimony of Dr. Venkayya

343.

CX-14 at 2018, 2033.


344.


IH at 163-65 (CX-·527); CX-1640; CX-19 at MS-
0001514;

IH at 186 (CX-1505).


345   On several occasions, MSC has denied that it competes with low-end and CAD-
embedded FEA solvers.  During a conference call on February 28, 2001, with securities analysts,
MSC's CEO stated that vertically integrated engineering software suppliers like SDRC (I-
DEAS), PTC (Pro-Mechanica), and Dassault (COSMOS, ELFINI) had not been exerting price
pressure or keeping MSC out of accounts.  Subsequently, during a conference call on May 2,
2001, with securities analysts, MSC's CEO stated that MSC seldom sees Dassault's Cosmos in
the market.  He explained that Cosmos is in the "design centric" market place and MSC's focus
has been on the high-end "process centric" market. CX-1375 (Feb. 28, 2001, MSC Conference

Call); CX-1882 (May 2, 2001, MSC Report on First Quarter 2001 Earnings).


346. Pro Mechanica is an FEA solver offering substantially different functionality and capabilities than advanced versions of Nastran. Pro Mechanica is supplied by Parametric Technology Corp. ("PTC"), a large CAD supplier. Pro Mechanica, however, is a low-end to mid-range product that is a module to PTC's CAD software. More importantly, Pro Mechanica is a P-element solver and not an H-element solver like most of Nastran. P-element is used for very detailed, specialized analysis of heavy or "chunky" components. It is an inefficient solver for larger-scale projects. P-element technology is unsuitable for general purpose structural analysis.


Pro Mechanica is not a substitute for NASTRAN. CX-1914, White Paper at 25;                at 259-60 (CX-1505);                III at 59-60 (CX-1418); CX-1857 at 2347.                IH at 166 (CX-1527); CX-1855 at MS-0002330. Anticipated testimony of                , and Dr. Venkayya..


347.

348.  PERMAS is a finite element solver from INTES in Stuttgart, Germany.

CX-900; CX-983

CX-988.

349.

IH at 258 (CX-1505); CX-1854 at MS-0002026, 2031.          IH at 285-86

(CX-1418);          IH at 82-83 (CX-1527). Anticipated testimony


350. Explicit codes like DYTRAN, LS-DYNA and PAM CRASH are exclusively designed

for the simulation of extreme events, such as, explosions. crashes, me: forming, etc. They are

not intended to or able to substitute for NASTRAN solvers. The extreme event simulation

involves highly nonlinear problems (both geometric and material non-linearities are involved)

with explicit time integration schemes with very small time steps.


Anticipated testimony of Dr. Venkayya.          IH at 28-31 (CX-2764);

Dep. at 315-16 (CX-1417).


5.    In-House Solvers

351.

IH at 259, 273-74 (CX-1418);

Dep. 162:6 to 164:7 (CX-1634);                    Dep. at

231-33 (CX-1525);                    Dep at 195 (CX-1491). Anticipated testimony

and of Dr. Venkayya.

## V.  Geographic Market

352.  The appropriate geographic market is the world, although local support may be a factor which limits U.S. consumers from turning to overseas suppliers.

## VI.  The Market Is Highly Concentrated

### A.  Market Participants and Market Concentration

353.  The relevant product market is comprised of MSC Nastran, UAI Nastran, and CSAR Nastran.  CX-1; CX-2; CX-13; CX-14; CX-15; CX-21; CX-22.

354.

CX-804

IH

at 132 (CX-1527)

CX-1610

III at 62-63 (CX-2764).

355. MSC's dominant market share has been relatively stable over the past ten years. A federal district court assumed for purposes of a summary judgment motion that MSC held a 90 percent market share of a Nastran market and UAI a five percent share in a monopolization case brought by UAI against MSC in the late 1980s. Five other firms were deemed to hold the remaining five percent. *Universal Analytics, Inc. v. The MacNeal-Schwendler Corp.*, 707 F. Supp. 1170 (C.D. Cal. 1989), *aff'd*, 914 F.2d 1256 (9th Cir. 1990).

356.

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357.

CX-3;          IH at 225

(CX-1505).

358.

IH at 226-27 (CX-1505); CX-1640

; CX-16                          ; CX-3; CX-1569 at MS-0002549, 2551; CX-14 at MS-0002018; CX-15 at MSC-02 002252, 2267; CX-2365.

155

359. Nastran market shares based upon (1998-99) pre-acquisition estimated revenue is set froth in the following table. These figures are based upon the financial statements of MSC, UAI, and CSAR, which generally do not separately break out Nastran license revenue from other revenue:

| | Estimated Sales (millions) | Market Share | Pre-Acquisition HHI | Post-Acquisition HHI |
|---|---|---|---|---|
| MSC | | | | 10000 |
| UAI | | | | |
| CSAR | | | | |
| Total: | | | | 10000 |

**B.** **Factors Affecting the Significance of Market Shares and Concentration**

**1.** **Market Concentration Understates Competitive Significance of UAI Nastran and CSAR Nastran**

360. Prior to the MSC's acquisitions, UAI and CSAR exercised greater competitive constraint on MSC then their respective market shares would indicate. At the time of the acquisitions, both UAI and CSAR were insurance for many customers that they had an alternative to MSC.

CX-1; CX-

156

2; CX-13; CX-14; CX-15; CX-14;

361.

. at 171 (CX-1413).

362.

CX-13; CX-14; CX-15; CX-1; CX-2.

363.

364. As noted above, many firms,

used UAI Nastran and CSAR Nastran as leverage to obtain better prices from

MSC. CX-1002 at 000042; CX-1003 at 000051; CX-1010 at 000114; CX-1012 at 000541.

365.

In early 1999,

UAI released an updated version of UAI Nastran and was planning to incorporate other new

features in the future,                                    UAI offered some non-linear

capability enabling it to seek more non-linear analysis work.                    IH at 72-

79, 85, 122-25, 140 (CX-1527);                    . (CX-1496); CX-1411 at Response to

Interrogatory 16.


    366.



                                    Astros, a Nastran-based advanced air flight analysis tool developed

for the U.S. Air Force that competed with MSC's FlightLoads software.

    IH at 87-88, 95-96, 111-116; 122-25;  213-15; 119-20, 125-27 (CX-1527);

Dep. (CX-1496); CX-1212; CX-1225; CX-13; CX-14 at MS-0002011;                    IH at

61-62, 75-76, 173, 182 (CX-1418); CX-2767 at      -00039.


    367.



    IH at 85-87 (CX-2764);

368.

III at 182-89 (CX-2764);

369.  CSAR also had successfully delivered new parallel processing Nastran technology to the Department of Defense in 1999

Anticipated Testimony          ; CX-2785 at MS-0002504;

370.

CX-489; CX-300 at 43004-   0003 (                                    );
CX-300 at 43004-  -0009 (bidders conference);  CX-13; CX-14; CX-1710.

2. **Market Concentration Understates Competitive Significance of UAI Nastran and CSAR Nastran If They Had Been Acquired by Other Software Suppliers**

371.

CX-1914 at 16-17, 17, 26-27; CX-20; CX-1; CX-2;                    IH at 166-68. 239 (CX-1505);                    IH at 88-89 (CX-1418);          IH at 205-06 (CX-1526); CX-3 at MS-0008634.

372.

CX-2; CX-1058; CX-2278 at MSC-64 000261.

373.

IH at 180-81; 232-33 (CX-1527).

374.

IH (CX-2764);    Dep. (CX-1498).

375.

IH at 235,

239 (CX-1505); CX-1557 at MSC-185 0001911-12; CX-20; CX-2; CX-3 at MS-0008634;

III at 224 (CX-1505); CX-1914 at 16-17, 26-27.

376.

CX-

1050 at    4743-52, 4753-54; anticipated testimony

377.

IH at 162-64, 168, 173 (CX-2764).

378.

CX-2632.

379.  MSC made the acquisitions of UAI and CSAR in order to keep them out of the hands of another engineering software firm.

CX-3 at MS-0008634;                          IH at 224 (CX-1505); CX-1914 at 16-17, 26-27;

CX-1; CX-2; CX-1616 at MS-0004199                                    IH at 159-61

(CX-1418); CX-1613 at MS-0004166                                            IH at

223-24                                              (CX-2764); CX-1895 at MS-0009654



                                                                         IH at 176,

185 (CX-1527);                         IH at 160-61, 192-93, 196 (CX-1418); CX-3 at MS-

0008634; anticipated testimony


    380.



                                                 010 (CX-2757);

    IH. at 200-01 (CX-1505);        Dep. (CX-1497); CX-3 at MS-0008634.

### 4. Even If Additional Solvers Where Included, the Market Remains Highly Concentrated

381. Even if other solvers such as the ANSYS solver were included in the market, it remains highly concentrated.

> CX-2663 (Data Set).

### 5. MSC-Dassault Strategic Alliance

382. MSC and Dassault have entered into a strategic alliance. Simultaneously with the announcement of the strategic alliance, Dassault acquired approximately a 9 percent interest in MSC, to become MSC's largest shareholder.

383.

> CX-2110; CX-2282; CX-2708
>
> CX-1894; CX-1844 at MS-0001595; CX-2490 at

0082; CX-1914 at 22; CX-2483.

## VII. Adverse Competitive Effects

### A. Likely Effects

#### 1. Price

384. Having found that MSC is the dominant supplier of advanced versions of Nastran in highly concentrated markets and that the acquisitions will significantly increase the level of concentration, there is a presumption that the acquisitions will substantially lessen competition. The acquisitions increase MSC's ability to unilaterally maintain prices above the competitive level. MSC no longer faced pricing pressure from its two closest substitutes, UAI Nastran and CSAR Nastran.

385.

CX-1

386.

CX-2

387.

CX-3; CX-2; CX-2278 at MSC-164-000261.

388.

(CX-1418); CX-6 at MSC0004061.

389.

IH at 260-62 (CX-2764); CX-8.

390. Several Nastran users are concerned by MSC's acquisitions. As noted above, these users had previously switched or threatened to switch, or had enjoyed the ability to switch to UAI Nastran or CSAR Nastran in the event that MSC raised prices or reduced Nastran development and enhancement. CX-105 (45001-    -0014); CX-106 (45001-        -0015); CX-1119
; CX-474; anticipated testimony of

CX-145.

391. In view of the pre-acquisition price erosion and falling prices, the acquisitions poses the threat that MSC will be able to halt the decline in prices or to even raise prices.

392.

CX-2237

## 2.    Increased Threat of Price Discrimination

393. Without the threat of losing business to and price pressure from UAI Nastran and CSAR Nastran, MSC may be better able to engage in price discrimination between customers following the acquisitions.    UAI's and CSAR's lower advanced Nastran prices and their respective willingness to provide more enhancements, lower prices, and unlimited site licenses had constrained MSC's ability to engage in price discrimination.

394.

Dep. at 307 (CX-1417);          Dep. (CX-1413);

IH. (CX-1527); CX-1569 at MS-0002549, 2551; CX-1316

Dep. at 56:1-20 (CX-1515);                          IH at 101:25 to 102:3

(CX-2515);          Dep. at 276:21 to 277:1 (CX-1414);

IH at 232:24 to 233:5 (CX-1418);                    Dep. at 79:19 to 80:3; 91:11 to

22, 122:17 to 22, 164:11 to 23 (CX-1416).

395.

IH at 120, 129-31

(CX-1505)                    ); CX-2023 at MSC-04 000307);          Dep. at 230-31 (CX-

1413); CX-1904; CX-1190;                    IH at 105 (CX-2515);                    IH at 10, 155 (CX-
1418); CX-1619 (MS-0005216,                                      anticipated testimony


CX-1569 at MS-0002554;                              EI. (CX-1527); CX-1569 at MS-0002549,
2551; CX-1904; CX-13; CX-14;          IH at 68-69, 101-06, 146-147, 214 (CX-2515);
IH at 219-21, 233-34, 276-77 (CX-1418); CX-1914 at 44 n.183; CX-1670 at MS-0011389 (
; CX-335 (        1-0005, 2001; CX-1885
CX-485; CX-484; CX-140 at        -0000211; CX-1569 at MS-0002547;
IH at 10, 155 (CX-1418);                     IH at 120, 129-31 (CX-1505)
III at 105 (CX-2515).


396.


                                                                            IH.
(CX-1527); CX-1569 at MS-0002549, 2551; CX-15 (MSC-02 002245).


397.                                                      Aeroelasticity is a
specialized functionality that is distinct to the aerospace industry. CX-13 (MSC-06 000110); CX-
14.


398.


168

CX-2292 (MSC -

18 019092 to 94);     Dep. (CX-1503, CX-1504); CX-490;  CX-328; CX-2100; CX-2101;

Dep. (CX-1418); CX-1885: CX-675 at     009604; CX-1710;  CX-1815; CX-302 at 2: CX-1023

at     0105; CX-1024 at    0168.


399.

CX-23 at MSC-18 032808.


400.

CX-24.


3.     **Likely Effects on Innovation**

401.  Competition between MSC, UAI, and CSAR had led to greater Nastran development and enhancements and pushed MSC to be more responsive to the needs for enhancement and develop at a lower cost.  The acquisitions deny consumers the benefits of that competition.

IH at 140, 151, 159 (CX-1505);          IH at 204 (CX-2515);

IH at 75-76, 270 (CX-1418); CX-1914  at 14, 25-26; CX-14 at MS-0002029

; CX-16 at MSC Ex. 13 at MS-0008486

CX-980; CX-19

CX-1627; CX-1422; CX-13; CX-14;      Dep. (CX-1492); CX-13; CX-14.

402.

CX-1914 at 11-13;                          IH at 87-88, 124-25 (CX-1527); CX-816 at     0238; CX-1788; CX-14;          IH at 151, 171, 176-77, 179-80 (CX-1418); anticipated testimony              CX-980;      Dep. (CX-1492)

403.

CX-1788

Dep. (CX-1492).

404.

Depo at 74-75 (CX-1417).

405.

CX-1200; CX-

1201;                              ;      Dep. (CX-1492)

406. .

407.

(MSC) IH (CX-1418); CX-14 at MS-0002035;      (MSC) IT1 at 75-76,

186, 194 (CX-1418);      (MSC) IH at 208-09 (CX-2512); CX-2771 at page 9 of 132.


### 4.   Coordinated Interaction

408. Each acquisition facilitated MSC's ability to engage in coordinated interaction.


Dep. (CX-1413).


409.


CX-2245 at MSC-162 000445, 46; CX-2328 (MSC-18 018856); CX-1589


### B.   Post-Acquisition Effects

410. Prior to the acquisitions, prices for MSC Nastran, UAI Nastran, and CSAR Nastran

had been falling.  MSC had long been experiencing price erosion in the market and had lowered

its prices to many customers by increasing discounts.

 Additionally, customers had an ongoing expectation that prices for software should decrease

over time.          CX-2510 (letter          to FTC dated June 25, 2001, at 4); CX-1419 at 5;

 Dep. (CX-1496).

411. MSC was aware of our investigation and, thus, could behave strategically by manipulating prices to avoid the appearance of the exercise of market power.

## 1. Higher Prices

412.

IH at 60-61, 166-67, 186-87, 194-95, 254 (CX-1418);　(MSC) IH at 242-43 (CX-2515);　(MSC) IH at 175 (CX-1505); CX-2062 at MSC-07 001060; CX-2271 at MSC-162 02921 to 2935; CX-12; CX-1047 at 04002-　-0001.

413.

IH at 44, 75-76, 181-82 (CX-1418); CX-1896 (MSC Price List, 7/28/2000); CX-14 at MS-0002011; CX-5 at MS-0004197, 4200; CX-1 at 699; CX-19 at MS-0001519.

414.

.

CX-9 (                                        ).


415.



CX-9 (

); CX-1047 at  04002-    -0001;    IH at 242-43 (CX-2515);    (MSC) IH at

175 (CX-1505);      (MSC) IH at 254 (CX-1418).



416.  Several former UAI Nastran and CSAR Nastran users are paying higher prices for

Nastran following the acquisitions.  MSC shifted these customers to the higher priced MSC

Nastran after discontinuing UAI Nastran and CSAR Nastran following the acquisitions.  In some

cases, MSC has offered to phase in the new higher prices over several years in order to avoid

customers taking a big hit in one year.  CX-1047;  CX-110;      (MSC) IH at 206-07, 254

(1418); CX-1047; CX-140 at    -0000201-206 (



); CX-1885; CX-675 at    009604.



417.  Former UAI Nastran and CSAR Nastran customers prefer retaining their UAI Nastran

and CSAR Nastran licenses and to pay the lower prices rather than switching to MSC Nastran and pay higher prices. These former UAI and CSAR customers had been satisfied with the price and product features offered by UAI Nastran and CSAR Nastran and did not need the purportedly greater features and capabilities found in MSC Nastran.

418. Both UAI Nastran and CSAR Nastran had some features that were not available from MSC. Thus, UAI Nastran and CSAR Nastran users preferred not switching to MSC Nastran. (MSC) IH at 151 (CX-1418); CX-2;    (MSC) Ex. 17 at MS-0003291 to 303 (CX-8).

419. Several MSC Nastran users were considering switching to UAI Nastran or CSAR Nastran in order to obtain lower prices. They are now paying higher Nastran prices than if they had been able to switch to the lower-priced versions of Nastran. Several MSC Nastran customers have been identified who are now paying higher prices following the acquisition because they could not switch to the lower-priced UAI Nastran and CSAR Nastran. These customers are
                                                              and      . Additionally, following the acquisitions, users could no longer use the availability of UAI Nastran and CSAR Nastran as leverage to obtain lower Nastran prices from MSC. CX-882;
CX-1885.

420. MSC had undertaken a series of published price increases since entering into these acquisitions

including

CX-1914 at 11, 44-45;     IH at 113-14 (CX-1505);     IH at 180-81 (CX-2515);     IH at 129 (CX-1418); CX-1888; CX-1638; CX-8; CX-2757.

421.

### 3.    Loss of Annual Licenses

422.  Prior to the acquisitions, MSC licensed its software three ways:  (a) paid-up, in which the customer licenses the software for an extended period and pays an annual maintenance fee for updates and technical support; (b) lease, in which the customer leases the software for a specific period of time, usually one year; and (c) usage, in which the customer pays based upon how much the software is used.

176

CX-1569 at MS-0002530; CX-2320;       IH at 99-103, 122, 124-29 (CX-2764);    (IH) (CX-2515);    Dep. (CX-1503 and CX-1504);       IH at 184;       Dep. at 101 (CX-1417)

423.

CX-2148; CX-346;       Dep. at 123 to 124 (CX-2516);       Dep. at 122 (CX-1415);    Dep. at 180 to 187 (CX-1491);    Dep. at 134 to 137 (CX-1416); CX-559.

424.

CX-24; CX-1852; CX-2461.

425.

Dep. (CX-2509).

### 4. Loss of Unlimited Usage Agreements

426.

Ex. 11 at MS-0009748 (CX-1657)

427.

(CX-1544);    IH at 150 (CX-1527).

428.    .

CX-1915; CX-1904; CX-1885; CX-840; CX-841.

429.

IH at 151-52 (CX-1527); IH at 103-04 (CX-2764); CX-835 at 0862,
0867.

430.

431.

Dep. (CX-1492); CX-843

432. Post-acquisition, MSC

CX-1956; Tr. at 81 to 83 and 174 to 175 (CX-1509);
; CX-2075 at MSC-09 001344. The following table shows the pattern of MSC's elimination or
planned elimination of

### MSC'S ELIMINATION OR PLANNED ELIMINATION OF
### SINCE THE ACQUISITIONS
### WITH ITS TEN LARGEST NORTH AMERICAN NASTRAN CUSTOMERS[2]

| RANK | CUSTOMER | PRE-ACQUISITIONS CONTRACTS | | POST-ACQUISITIONS CONTRACTS | | SOURCE |
|---|---|---|---|---|---|---|
| | | PERIOD | TYPE | PERIOD | TYPE | |
| 1 | | | | | | |
| | | | | | | |

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[2] This table is subject to change as further discovery is conducted.

180

| RANK | CUSTOMER | PRE-ACQUISITIONS CONTRACTS | | POST-ACQUISITIONS CONTRACTS | | SOURCE |
|---|---|---|---|---|---|---|
| | | PERIOD | TYPE | PERIOD | TYPE | |
| | | | | | | Dep. at 248 to 52 (CX-1414) |
| 2 | | | | | | |
| | | | | | | CX-482<br><br>CX-335 at 01-0007 to 8<br><br>CX-337<br><br><br>TR. at 376-377 |
| | | | | | | CX-2095; CX-2159 at MSC-134-000106 |
| 3 | | | | | | |
| | | | | | | Dep. at 59 to 60 (CX-2516) |

| RANK | CUSTOMER | PRE-ACQUISITIONS CONTRACTS | | POST-ACQUISITIONS CONTRACTS | | SOURCE |
|---|---|---|---|---|---|---|
| | | PERIOD | TYPE | PERIOD | TYPE | |
| | | | | | | CX-140 at - 0000201 to 06; CX-1929 at MSC 74 001789 to 93 |
| 4 | | | | | | Dep. at 84 (CX-1509); CX-1956 |
| 5 | | | | | | |
| | | | | | | Dep. at 84 (CX-1509); CX-1956 |
| 7 | | | | | | Dep. at 84 (CX-1509); CX-1956 |
| 8 | | | | | | CX-1920 |
| 9 | | | | | | CX-2113; Dep. at 236-38 (CX-1413) |

| RANK | CUSTOMER | PRE-ACQUISITIONS CONTRACTS | | POST-ACQUISITIONS CONTRACTS | | SOURCE |
|------|----------|---------|------|--------|------|--------|
|      |          | PERIOD  | TYPE | PERIOD | TYPE |        |
| 10   |          |         |      |        |      | CX-2402 |

**5. Loss of Features and New Enhancements**

433.

Dep. (CX-1942)

434.

.

. CX-24.

6. Loss of "No-Service" Option

435.

IH at 186-87 (CX-2515).

CX-1914 at 13; CX-2;

IH at 106-08, 212-214 (CX-2764); CX-1818.

C. Increased Time and Cost for New Firms to Offer Nastran

436.

(MSC) IH Ex. 2 at MS-0002031, 2035; (CX-14); CX-20; CX-1; CX-2; CX-3; CX-1914 at 16-17, 26-27.

437.

184

IH at 224, 239 (CX-1505);        (MSC) Ex. 21 at MS-0008634 (CX-3); CX-1914 at
16-17, 26-27.

438.

.

CX-1914 at 16-17, 26-27; CX-1.

.

439.

CX-2 at 10.

440.

. CX-1557 at MS-0001911;     IH at 235, 239
(CX-1505).

441.

CX-1914 at 36-37.

442.

(CX-2764);        IH Ex. 2 at MS-0002031 (CX-14).


443.


IH at 141-43, 166-67, 180-82 (CX-1527) .


444.


## VIII.  Entry Is Not Likely nor Timely nor Would It Be Sufficient


### A.    Stagnant Demand

445.

CX-1640 at MS-0008622.


CX-2365


### B.    Timeliness of Entry

446. Any entry has already taken over two years.  None has occurred during the more than

two years since the acquisitions   There was an incentive to enter immediately.

An expanded period for entry is needed to learn of customers needs. As Nastran evolves, a supplier needs an extended history of working with customers so that it can best channel its development toward the evolving needs of customers. An expanded period is also needed to develop credibility with the customer to assure the customer that the supplier is a sound supplier upon which the customer can rely in the future. Customers will be reluctant turning to a supplier that does not have a history of reliability and projection of the ability to continue developing the product in the future. It also takes time to verify a new code.

### C.    Likelihood and Sufficiency of Entry

447.

CX-1914 at 37.

448. It would not be technically feasible for any company to start now with the publicly available version of Cosmic Nastran, and develop a commercially acceptable version of Nastran within the next two to five years.

This is not simply a matter of throwing resources at the problem. Much FEA solver development work must proceed sequentially, and cannot be done in parallel. Doubling the size of the development staff will not double the rate at which the software can be upgraded.

Anticipated testimony of Dr. Venkayya; CX-2 at MS-0008634; IH 225:1-23
(CX-1505).

449.

CX-2365.

CX-0024 at MSC-
18 033039.

IH 134 (CX-1527).

450.

CX-2365.

451.

CX-2053; CX-25.

CX-1565; CX-25; CX-1956.

452.

CX-1837 at MS-0001042.

453.

CX-3 at MS-0008634;     IH at 225-26 (CX-1505).

454.

201-03 (CX-2764);       IH at 239-40 (CX-1527).

455.  There has been no new successful Nastran entry during the past 15 years since CSAR's entry.  CX-1403.

456.  Developing a new advanced version of Nastran would entail a substantial number of complex, protracted, and costly steps and take more than two years.  The prospective new entrant would first need to write a substantial amount of complex computer source code.  Many new features and capabilities have been added to the NASA public domain version over the past 15 to 30 years by MSC, UAI, and CSAR.  The prospective new entrant must then run extensive benchmark studies to validate the accuracy of its new version of Nastran.  The prospective new entrant must also convince customers to begin to use its Nastran in order to establish the product's reliability and the company's commitment to quality support services and long-term Nastran development.  Finally, the prospective new entrant must find and hire technical sales and support staff in order to establish a distribution and service organization.  CX-3;

457.  Once a new Nastran code is developed, substantial time is needed by any new entrant to validate the accuracy of the new code, to establish a reputation for reliability, and to build a development, distribution, and customer support program.  Users place heavy reliance on the predictive value

of Nastran results and are unlikely to substitute a new version of Nastran without a substantial level of confidence in its accuracy. It takes time for an industry to develop such confidence in another solver, particularly where the risk of failure is as great as in the aerospace and automotive industries.

458. The development costs would be sunk (they are enhancements tailored to the Nastran code that cannot be redeployed outside of the Nastran market), making the investment particularly risky in view of the projected lack of substantial future growth in Nastran usage. IH at 225-26 (CX-1505); CX-3.

459. The cost and time of entry through development of NASA's public domain version of Nastran is estimated to be in the range of                    and  a minimum of
 of development time.  CX-3 at MS-0008634;      IH at 225-26 (CX-1505);       IH at 246 (CX-1418);                                                .

460. The substantial time and cost to develop a new Nastran code is also reflected in

. CX-1567 at 2382; CX-2785.

461. Entry by a new Nastran solver is also difficult if the new entrant does not own its pre- and post-processor. Commercial pre- and post-processors tend only to create models for the

most popular solvers and not for "smaller player's programs."

IH at 225-29 (CX-2764);    IH at 65,

121-28, 24? (CX-1418); CX-1548; CX-1913 at MS-36565; CX-21 at 2334.

462.  While entry will be facilitated by large customers willing to fund a new entrant, entry

sufficient to defeat a price increase would still take more than two years.

In view of the Nastran development and enhancements since

the early 1990s, a new entrant beginning today to develop the public domain version of Nastran

with the support of large customers would likely need even more development time than CSAR

in the early 1990s.

(CX-1914); CX-309.

**D.    AI Nastran (Harry Schaeffer/Richard MacNeal & Ansys)**

463.

CX-2646.

Dr. Harry Schaeffer, a long-standing Nastran lecturer, author, and expert and Dr. Richard MacNeal, co-founder and former CEO of MSC until 1997. Schaeffer had previously offered a Windows version of Nastran known as Schaeffer Simulation Software Nastran, which was unsuccessful following MSC's introduction of its Windows version of Nastran. Schaeffer and MacNeal left retirement to undertake this venture. Dr. Schaeffer is 65 and Dr. MacNeal is 77. CX-2627. Anticipated testimony

464.

CX-2613 at 03759.

CX-2613 at 03753.

CX-2612 at 03606.

CX-2613 at ANSYS 03759.

194

465.

. CX-2627; Anticipated

Testimony

466.

CX-2156.

## IX. MSC's Efficiency Claims

### A. MSC Has Not Prepared Any Efficiencies Study

467.

CX-1405; White Paper at 15, 18, 45 (CX-1914);          IH at 206-213, 265 (CX-1505).

468. MSC has not submitted an efficiencies report by an economic or accounting expert during this litigation.

CX-1524.

## B. Fixed Cost Savings

469.

CX-1405 at 19.

470.

In the litigation, MSC has not further described or quantified any fixed cost savings. CX-1410; CX-1405.

## C. Engineering Personnel Were Available Without the Acquisitions

471.

CX-1405 at 19-20; CX-1410; CX-1641 at

MS-0008635.

472. The developers MSC obtained from UAI and CSAR represent   of   MSC developers.

..

iH at 175-76 (CX-1418); CX-1914 at 14-15, 39; CX-1409;       Dep. at 96:14 to 96:19 (CX-1518).

473. MSC had other ways of obtaining engineering personnel. It has regularly hired engineers from other sources, such through use of headhunters or advertisements, for its growing development work. Additionally, MSC could train any new hires for development work.

TH at 151-58, 206-07 (CX-1505); CX-

1405;        IH at 202-03 (CX-2515); CX-1568 at MS-0002432;        TH at 174-76, 199-

201 (CX-1418);                                        IH at 46-49, 171-72 (CX-1527)

CX-1612 at MS-004149; Universal Analytics, Inc. v. The MacNeal-Schwendler

Corp., 707 F. Supp. 1170 (C.D. Cal. 1989), *aff'd*, 914 F.2d 1256 (9th Cir. 1990); X-1914; CX-

1568 at MS-002434; CX-2749; CX-1405; CX-2470; CX-1567; CX-2344.


474.  Another way that MSC obtained engineers was through less anticompetitive

acquisitions.  MSC obtained programmers through its acquisitions of MARC and Knowledge

Revolution.        Dep. at 116-17 (CX-2513).


475.


                                        Dep. at 200 (CX-1417);        IH at 202-03

(CX-2515); CX-1568 at MS-0002432;        III at 174-76, 199-201 (CX-1418);        IH at

155-58, 206-07 (CX-1505); anticipated testimony


476.

                CX-1408; CX-1409; anticipated testimony

477.  MSC has extensive engineering training capabilities.  CX-1914.

478.  There is no evidence that MSC could not obtain engineers through recruitment or training.

**D.  MSC Could Implement the UAI and CSAR Features Without the Acquisitions**

479.  As discussed in the remedies section, MSC has integrated features of UAI Nastran and CSAR Nastran into MSC Nastran.  There is no evidence that the acquisitions of UAI and CSAR were the only way in wh. ·h MSC could develop the integrated features.  MSC had the largest team of developers in the industry.

CX-2482.

**XI.  Remedy**

**A.  The Need for MSC Nastran Clones**

480.  Any new entrants would need to offer a clone of MSC Nastran if it is to begin competing immediately.  A MSC Nastran clone offering the same features and capabilities users find in MSC Nastran is the only practical solver that could expect to a realistic alternative for

customers. The UAI Nastran and CSAR Nastran codes are not out of date and reintroducing

them into the market would have little affect on competition. Additionally, customers

accustomed to MSC Nastran, including former UAI Nastran and CSAR Nastran users who MSC

has switched to MSC Nastran may now be reluctant to switch again. Anticipated Testimony of

## 1. Integration of UAI and CSAR Features Into MSC Nastran

### a. CSAR Integration

481.

CX-1865 at MS-0003291,

482.  Since the acquisition of CSAR, MSC developers have incorporated features of

CSAR/NASTRAN into MSC NASTRAN.

Dep. at 196-97 (CX-1518); CX-2481 at MSC-75 000820; CX-1914; CX-1410.


**b.    UAI Integration**

483.  MSC has also incorporated many UAI NASTRAN features into MSC NASTRAN

CX-209 at MSC-127

000117; CX-2520; CX-2479; MSC White Paper at 42 (CX-1914); CX-1410.


484.


Ex. 5 (CX-1404);        Tr. at 174 (CX-1518)


CX-2783.


485.

Ex. 5 (CX-1404).

Tr. at 178-79

(CX-1518); see also *Id.* at 98-99, 111-16, 221-23

Dyer Dep

at 242-43 (CX-1503)

CX-2783

486.

Tr. at 216 (CX-1518).

### 2. Major Updates to MSC Nastran Since the Acquisitions

487. MSC had released MSC NASTRAN Enhancements Version 70.6 in February 1999,

the more recent version prior to the acquisitions. Since then, MSC has issued two new versions.

MSC Response to Interrogatory 16 (CX-1411). In October 1999, MSC issued Enhancements

Versions 70.7. This version contained 34 categories in new enhancements. MSC Response to

Interrogatory 16 (CX-1411)(identifying each category of enhancements).

488.  MSC introduced its next version – MSC/NASTRAN 2001 · in April 2001.  This was a major new release and the most aggressive in over five years.  This version contains 64 categories of new enhancements to MSC/NASTRAN.  MSC's Release Guide For The 2001 version states that "[m]any new features . . . have been added to MSC/NASTRAN 2001" and sets forth "a short overview of the most significant features introduced in MSC/NASTRAN 2001" and sets forth "a short overview of the most significant features introduced in MSC/NASTRAN 2001."  MSC Response to Interrogatory 16 (CX-1411);  MSC/NASTRAN 2001, Release Guide, Ibrahim, Ex. 17 (CX-2158); CX-113 at 45001 GRRD-0179.

489.

CX-1410.

490.  MSC Nastran 2001 contains efficiency enhancements with parallel processor solution capabilities.  CX-2110

491.  Former developers from UAI and CSAR employed by MSC made major contributions to all MSC Nastran updates since MSC acquired UAI and CSAR.  MSC Response to Interrogatory 16 (CX-1411).

### 3.  No Updating of UAI Nastran and CSAR Nastran

492.  The latest version of UAI NASTRAN to be released was Enhancements Version 20.1 in June

1999.  Since the acquisition of UAI, MSC has not issued any subsequent version of UAI

NASTRAN with any enhancements.  MSC Response to Interrogatory 16 (CX-1411).


493.  The latest version of CSAR/NASTRAN to be released was Enhancements Version

98.  *Id.*  Since the acquisition of CSAR, MSC has not issued any subsequent version of

CSAR/NASTRAN with any enhancements.  MSC Response to Interrogatory 16 (CX-1411);

Dep. at 170 (CX-1491)


494.


MSC Response to

Interrogatory 16 (CX-1411); MSC Accounting Data Report re CSAR and UAI Sales.


495.


CX-2783.


496.

CX-2610.

## B. The Need For Recision of Paid-Up Contracts

497.

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CX-2100 at MSC-134 004038.

498.

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499.

CX-2100; CX-2176.

500.

(CX-25).

### C. The Need For Sharing of Pipeline of New Enhancements Under Development

501. Any new entrant will need to assume ongoing development projects until it is able to undertake its own development projects. Without access to the pending development projects, the new entrants will quickly fall behind MSC's development. Anticipated Testimony

### D. The Need For Customer Lists and Customer Information

502. A new entrant will need access to customer lists and customer information in order to identify persons to contact at each account and how must to target its sales efforts to each account. Anticipated Testimony

### E. The Need For Access To Employees

503. The acquirer may need developers and technical support people at least equivalent to

the number maintained by UAl and CSAR, that is, around          persons.  Anticipated testimony

of                                                              Dep. 188:16-25,

270:21 to 271:13 (CX-1518).

504.  The steps identified above regarding entry would also be applicable to the assets and
steps needed to ensure divestiture fully supports the new entry.

**F.  The Need For Interfaces with Complementary Software**

505.

CX-1406.

506.

507. MSC has tools to deny or impede access to the market for any new Nastran supplier.

Since any new Nastran solver will need to assure users that they will have available an established pre- and post-processors, steps must be taken to ensure that MSC does not take steps that undermine the new Nastran's ability to offer a product that is competitive with MSC Nastran.

Dept 82-83 (CX-1417); CX-21 at 2334.
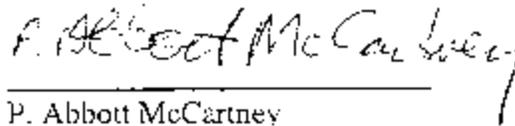
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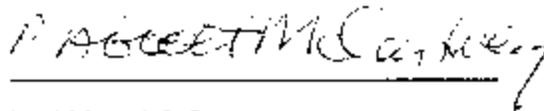Washington, D.C. 20580
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Dated: June 14, 2002 (Public Version June 21, 2002)

## CERTIFICATE OF SERVICE

This is to certify that on June 21, 2002, I caused a copy of the Public Record Version of Complaint Counsel's Pre-Trial Proposed Findings of Fact to be served on the following persons:

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