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AN EMPIRICAL STUDY OF INFORMATION SYSTEMS PROFESSIONALS' PRODUCTIVITY PERCEPTIONS OF CASE TECHNOLOGY

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ABSTRACT

This paper describes an empirical study of information systems professionals' productivity perceptions of computer-aided software engineering (CASE) technology. The leading Management Information Systems scholarly and trade journals consistently point out the need for improving the quality of delivered information systems and the productivity of the professionals that produce them. Large enterprises across most industries are investigating and using CASE technology with the hope that it will deliver significant improvements in information systems quality and productivity.

Our research investigated productivity perceptions of information systems professionals that use CASE technology. Using a personal computer based survey instrument, CASE technology functions were compared using the method of paired comparison. A rank ordering of the results revealed that Data Flow Diagramming and the Data Dictionary maintenance functions were perceived to be the functions that contributed the most to improving the respondent's productivity.

1. INTRODUCTION

Two recent studies (Hartog and Herbert 1986; Brancheau and Wetherbe 1987) identified software development and productivity as pressing issues facing Management Information Systems (MIS) managers. McLean (1979) identified several actions being taken by MIS managers to be more responsive to user needs, one being the introduction of tools to make the MIS staff more productive.

Automated support tools for information systems analysis and design methodologies is an ongoing domain of research with PSL/PSA (Teichroew 1974) representing an early commercial product coming from this research. More recently, researchers have focused their work on integrated development environments (Newman 1982; Wasserman 1982; Konsynski 1984; Konsynski et al. 1984; Hoffnagle and Beregi 1985). The current generation of commercially available computer aided software engineering (CASE) technology has also integrated the workbench tools used by information systems professionals in the hopes of achieving higher productivity and higher quality systems.

One is hard-pressed to find a uniform definition or architecture (attributes) for CASE in the literature. A review of over 400 advance workshop papers for CASE '87 (Chikofsky 1987) and CASE '88 (Chikofsky 1988) reveals that researchers and practitioners do not even agree on the CASE acronym or on what words the CASE acronym represents. The definition preferred by the authors is "the application of automated technologies to the software engineering procedures" (Case 1986), and one robust attribute list for a full CASE product is presented by Jones (1987).

Estimates indicate that hundreds of large enterprises are now using CASE technology as part of their information system development process with the intuition that "this is the way to go" for improved productivity and system quality, and industry analysts are projecting the market for CASE software to grow to nearly $1 billion in 1990 (Betts 1987; Suydam 1987). On the surface, this appears encouraging because CASE technology introduces a certain amount of rigor and uniformity into the systems development process; however, Ball (1987) observed enterprises that had purchased multiple copies of two of the leading PC-based CASE products and found that the product was predominately being used to prepare graphical presentations for users and managers. The type of use Ball observed barely goes beyond the capabilities found in most "Draw" type software (e.g., PC PAINT, DR. HALO, MAC DRAW, MAC PAINT, etc.).

There is little debate in the MIS community regarding the need for improved productivity. Konsynski (1984) points out the potential serious ramifications caused by a lack of information systems development productivity improvements, and goes on to state that "research in this area is sparse, but we can expect a productivity increase of no more than 25% through adoption of techniques that do not fundamentally change the development activity."

It can be argued that CASE technology fundamentally changes the development activity. CASE with its completeness and consistency checking and standardization and formalism can introduce more of an engineering aspect into the information systems development process. This process has traditionally relied upon the artistic and cognitive abilities of individuals to accomplish these same tasks. As the magnitude and scope of the information systems development project increases, it becomes questionable whether human cognitive processes are capable of performing these tasks in an efficient and effective manner. The current generation of information systems, characterized by system integration, distribution and interactivity, are no doubt far more complex than those of their predecessors. Because of these characteristics, a definite need exists to automate as much of the information systems development cycle as possible. Even though there is a pressing need to automate, at least one major question still remains unanswered: how does CASE technology affect the productivity of its users and ultimately affect the enterprise's bottom line?

2. FOCUS AND HYPOTHESIS

Because there is a dearth of empirical literature either supporting or disputing the productivity claims for CASE technology, we conducted a survey focusing on the question "How does CASE technology affect the productivity of its users?" One prior survey conducted by a CASE vendor (Corkery 1986) revealed that productivity of its CASE product users improved by an average of over 30 percent in both analysis and design activities. Additional empirical work such as this has not been widely reported in the academic or trade journals.

Our study investigates information systems professionals' productivity perceptions of which functional parts (i.e., tools) of a specific CASE product contribute the most to increasing their productivity. Because all of the stimuli were either tools or processes that the respondents could use either manually or with the CASE product, we asked them to consider doing the same task manually and then with automated support from the CASE product. Our hypothesis is that information systems professionals can identify the functional parts of CASE products that they perceive as contributing the most to increasing their productivity over comparable manual methods. The respondents' ordering preferences will be used to test our hypothesis. Our approach for this study was inspired by several studies that investigated programmer productivity techniques and tools (Nowaczyk 1984; Wiedenbeck 1985; Jones 1978; Thadhani 1984; Hanson and Rosinski 1985).

3. METHODOLOGY AND SUBJECTS

The survey methodology was used to test our hypothesis about information systems professionals' perceived perceptions of productivity. A personal computer diskette based survey instrument was used to capture perceptions of the subject's productivity comparing the functional parts of CASE technology to comparable manual methods.

Ninety-nine subjects from 47 enterprises from the United States and Canada volunteered to participate in the survey. Subjects were users of Excelerator (registered trademark of Index Technology Corporation), a commercially available, PC-based, integrated CASE product, and from a representative cross-section of industries.

There were 56 unique position titles reported by the respondents, many being variations of common titles including title gradations such as junior or senior. For purposes of this paper, the entire group of respondents constitutes our label of "information systems professionals."

Seventy-nine percent of the respondents reported that they have been using Excelerator for less than 18 months. This correlates very closely with their response to how long they have been using any CASE product.

Each enterprise was sent at least one diskette that contained the survey software and question database. The subjects provided initial demographic information, responded to the survey's questions, could request "help" from the software, and were allowed to make comments at the conclusion of the survey. The completed survey diskettes were mailed back to us for analysis of the data. Ninety-two percent of the subjects completed the survey, and a thorough discussion of the survey's administration is available (Norman 1987).

4. THE SURVEY'S DESIGN

Our PC-based survey was designed to provide a rank ordering of the CASE product functional parts as well as compare individual functional parts to each other using appropriate statistical techniques. Pairs of stimuli were presented to the subjects who were to indicate which of the stimuli provided the greater productivity improvement over comparable manual methods.

In addition to the functionalities selected for this study, we chose two additional stimulus items - communication among project team members and adherence to the enterprise's information systems development standards. These two stimuli, although not workbench tools, are a significant and integral part of the information systems development process, and, as such, we wanted to find out if the respondents would perceive an improvement in these two processes when CASE technology is being used. Our hypothesis is that CASE products significantly improve the quality of each of these two information system development aspects. Table 1 is an alphabetized list of the CASE technology functional parts investigated, and Appendix A gives the definition of each one.

Table 1. CASE Product Component Parts Investigated

1. Analysis → Graph Analysis
2. Analysis → Entity List
3. Analysis → Report Writer
4. Data Dictionary
5. Data Flow Diagram (Gane & Sarson, Yourdon)
6. Entity/relationship data model (Chen or Merise)
7. Excelerator works on both PC and mainframe
8. Import and/or Export Facility
9. LAN support
10. Logical Data Model diagram (IBM)
11. Presentation Graphics
12. Project member's communication via Excelerator
13. Project standardization
14. Record Layout Generation
15. Screen/Report Design
16. Structure Charts (Constantine)
17. Structure Diagrams (Jackson)

5. RESULTS

This section presents the results of the testing of the hypotheses concerning the respondents' perceptions of productivity when using CASE products. The first hypothesis as presented earlier in the paper is:

> **Information systems professionals can identify, via their perceived ordering preferences, the parts of CASE products that contribute the most to increasing their productivity over manual methods.**

The null hypothesis suggests that the subjects were responding in a purely random manner. To reject the null hypothesis we analyzed the individual subject responses as well as aggregated responses over all subjects using a computer program based on methods of paired comparisons and Coefficient of Consistence for each of the respondents and Coefficient of Agreement over all respondents (David 1963; Edwards 1957; Kendall 1962; Hill 1953; Ferguson 1971). The level of significance chosen for the test of the null hypothesis was .01.

Our data validation process looked for outliers relative to the other subjects in order to identify any of the respondents that were responding in a purely random manner. The results reported in Table 2 allow us to reject the null hypothesis and conclude that each respondent was operating with a consistent pattern which is significantly better than chance.

Table 2. Coefficient of Consistence Taxonomy for PC-Based Survey Respondents

Range of the Coefficient of Consistence	Number of Respondents
0.90 to 1.00	30
0.80 to 0.89	40
0.70 to 0.79	12
0.60 to 0.69	7
0.50 to 0.59	2
Total Respondents:	91

The rank ordering of the CASE product's 17 functional parts, according to the preference of the respondents, is shown in Table 3 along with the number of times each functional part was preferred (selected) by the respondents over the other functional parts. The second numerical column in the table gives the percentage of times the functional part was selected out of the maximum possible number of times. The right-most column of the table provides the relative percent of the choices normalized to the choice frequency of the functional part listed first.

Table 3. CASE Product Productivity Ranking (n=91)

Stimulus Item	Number of Times Selected	Percent Selected	Relative Choice
Data Flow Diagram	1155	0.79	1.00
Data Dictionary	1128	0.77	0.98
Project Standardization	862	0.59	0.75
Screen/Report Design	857	0.59	0.74
Presentation Graphics	854	0.59	0.74
Analysis → Report Writer	827	0.57	0.72
Analysis → Entity List	728	0.50	0.63
Entity/Relationship data model	726	0.50	0.63
Structure Charts	721	0.50	0.62
Logical Data Model	712	0.49	0.62
Analysis → Graph Analysis	683	0.47	0.59
Project member's communication via CASE product	616	0.42	0.53
Structure Diagrams	602	0.41	0.52
Record Layout Generation	598	0.41	0.52
Import and/or Export Facility	577	0.40	0.50
CASE product works on both PC and mainframe	453	0.31	0.39
LAN support for the CASE product	277	0.19	0.24
Total Choices	12,376		
Total Choices Per Item	1,456		

6. DISCUSSION

The respondents selected "Data Flow Diagrams" as their number one choice (selected 79 percent of the time) for improved productivity over manual methods. Knowing the amount of effort needed to manually create and modify Data Flow Diagrams, we can appreciate why this function was perceived to deliver the most productivity over manual methods. Coupled with the observation that the data modeling stimuli were ranked lower, it might also suggest that the respondents were making greater use of this process modeling tool.

The "Data Dictionary" stimulus item was perceived as the number two choice (selected 77 percent of the time). The continuing nature of data dictionary enhancement and maintenance is labor intensive, and automation of this function should contribute positively to productivity. Populating Excelerator's Data Dictionary is largely integrated with the use of the data or process modeling tools; therefore, the respondents could be perceiving a productivity improvement compared to populating and maintaining a data dictionary in a non-integrative manual fashion.

The next three stimuli (Project Standardization, Screen/Report Design, and Presentation Graphics) were selected 59 percent of the time. It was not surprising to us that Project Standardization ranked this high as our initial hypothesis was that enterprise information systems development standards would be enhanced with the adoption of CASE technology and these results tend to support this belief. The remaining two functions, while tied at 59 percent may represent those that are used quite heavily and, like the functions ranked number 1 and 2, are labor intensive when done manually. Ball (1987) and others in verbal communication with the authors have found that many enterprises begin their use of CASE technology with these functions.

With respect to the stimulus item "Communication among project team members," we had hoped that it would appear high in the rankings list thus supporting the notion that CASE technology enhances communication among participants. Ward (1984) argues that the essential element in information systems development is the understanding of the human communication processes involved in this activity. Other researchers have investigated this issue (Elam, Guinan, and Henderson 1987; Guinan and Bostrom 1986; Cronan and Means 1984; Cronan 1984), however none have reported on the effects of CASE technology on team member communication.

Our survey results reveal that this is not the case based on these respondents' perceptions. Communication placed twelfth in the list, possibly indicating that the respondents perceive that CASE technology contributes more to supporting their technical needs than with the communication needs among participants.

Looking at the bottom of the rankings, we find that the respondents perceive "LAN support" to contribute minimally to their increased productivity over manual methods being selected just 19 percent of the time. This does not necessarily mean that they obtain no increased productivity with this function, but rather, relative to the other functions, they receive minimal increased productivity. The second to the last ranked function was "Excelerator works on both a PC and a Mainframe," and was selected 31 percent of the time in the pairwise comparisons. The respondents also perceive very little productivity improvement with this function. In discussing CASE technology with several practitioners, we found very few using the LAN and PC to mainframe link capabilities of the CASE product. In most instances, one or two information systems professionals were working on the same project on the same workstation.

7. SUMMARY

Our observations must be tempered given the notion of using information systems professionals' perceptions of productivity and that the respondents all used the same CASE product. We believe our results are representative of the Excelerator User's Group as of the time of the study since the participating enterprises came from this group. However, we must be careful in extending the results beyond this population of users.

The respondents were clearly able to identify the component parts of a specific CASE product that they perceived as contributing the most to their productivity over manual methods, and they identified the components that provided minimal contribution to their productivity as well.

The results of this study could have implications for information systems professionals, software engineering vendors, and software engineering researchers. Some implications for information systems professionals might be:

1. CASE technology should not be viewed as the total solution for their systems development problems. It is doubtful that any technology will substitute for improving their problem solving skills. Several studies (Vitalari 1981, 1985; Vitalari and Dickson 1983; Eliot 1985) have investigated problem solving strategies during the Requirements Determination phase of systems development and the recommendations from these studies have not been incorporated in current CASE technology.

2. This study shows via the respondents' perceptions that productivity improvements were attributed to CASE technology. It also identified the component parts of a specific CASE product that were perceived to provide the most productivity as well as those that offered the least improved productivity. Information

systems professionals that use other CASE products may be able to draw some inferences from this study as many of the CASE products have generic equivalents of the stimuli used in this survey.

3. The study also indicates that there are perceived productivity improvements attributed to adherence to the enterprise's systems development standards when using CASE technology. This is significant in light of the fact that most of the larger enterprises have rigorous system development methodologies and associated standards.

4. This study is a step towards rigorous validation of the effects of CASE technology on information systems professionals' productivity. Information systems managers are continuously faced with large backlogs, employee turnover, and pressure to develop higher quality systems in a more cost effective manner. CASE technology appears to be a valuable contribution for improving the productivity of its users.

The implications for software engineering vendors may be positive. The perceptions of the respondents in this survey appear to show that CASE technology increases productivity over manual methods. This study did not attempt to measure the degree of productivity improvement, but represents a step in that direction. The intuitive claims about improved productivity made by vendors have been supported through this study, however the amount of productivity improvement was not investigated. Two suggestions for the vendors are:

1. Continued enhancement of their product offerings to address those facets of information systems professionals' jobs that will deliver the greatest increases in productivity coupled with increased system quality.

2. CASE product offerings need not be as robust in functionality as the product used for the survey in order to positively affect productivity. Based on the sample population's perceptions, it appears that "LAN Support" and "CASE product works on PC and Mainframe" are perceived as being less valuable in terms of productivity when compared to the other functions in the survey. This finding may support Jones' (1987) notion of building an "incremental" CASE product.

The implications for software engineering researchers may be that they should continue to push the frontiers of technology to continue to automate more of the front-end of the system development effort. Much of the Requirements Determination work of information systems professionals is accomplished before they use the CASE product; thus research for the automation of this activity should receive significant attention in the coming years.

This study represents an empirical investigation of CASE technology and its perceived effects on information systems professionals' productivity. Future empirical work investigating CASE technology is needed to establish a productivity metric or range of metrics. In addition to a productivity measure, many behavioral issues still need to be investigated with the intent of improving the utilization and effectiveness of future generations of CASE technology.

8. SELECTED BIBLIOGRAPHY

Ball, S. "Successful Implementation of Computer-Aided Software Engineering." In E. Chikofsky (ed), *Advance Papers for the First International Workshop on Computer-Aided Software Engineering*, Vols. 1 and 2, May 27-29, 1987, Cambridge, Massachusetts, 1987, pp. 128-138.

Betts, M. "Firm Readies Automation Tool." *Computerworld*, January 19, 1987, p. 13.

Brancheau, J. C., and Wetherbe, J.C. "Key Issues in Information Systems Management." *MIS Quarterly*, March 1987, pp. 23-45.

Case, A. F., Jr. *Information Systems Development: Principles of Computer-Aided Software Engineering*, Englewood Cliffs, NJ: Prentice-Hall, 1986.

Chikofsky, E. (ed). *Advance Papers for the First International Workshop on Computer-Aided Software Engineering*, Vols. 1 and 2, May 27-29, 1987, Cambridge, Massachusetts, 1987.

Chikofsky, E. (ed). *Advance Papers for the Second International Workshop on Computer-Aided Software Engineering*, Vols. 1 and 2, July 12-15, 1988, Cambridge, Massachusetts, 1988.

Corkery, M. "XL/Tutor: 1986 Excelerator User Survey Results." *InTechniques*, Index Technology Corporation, Issue 4, November/December 1986.

Cronan, T. P. "Application Systems Development: A Communication Model for Business Users and DP Personnel." *Data Base*, Vol. 16, No. 1, Fall 1984, pp. 21-26.

Cronan, T. P., and Means, T. L. "System Development: An Empirical Study of User Communication." *Data Base*, Vol. 15, No. 3, Spring 1984, pp. 25-33.

David, H. A. *The Method of Paired Comparisons*. In M. G. Kendall (ed.), *Griffin's Statistical Monographs and Courses*, Number 12, New York, NY: Hafner Publishing Company, 1963.

Edwards, A. L. *Techniques of Attitude Scale Construction*. New York, NY: Appleton-Century-Crofts, 1957.

Elam, J. J.; Guinan, P. J.; and Henderson, J. C. "Studying Design Teams -- Contrasting Approaches." In J. I. DeGross and C. H. Kriebel (eds.), *Proceedings of the Eighth International Conference on Information Systems*, 1987, pp. 463-464.

Eliot, L. B. "An Investigation of Information Requirements Determination and Analogical Problem Solving." Unpublished Ph.D. Dissertation, University of Southern California, 1985.

Ferguson, G. A. *Statistical Analysis in Psychology and Education*, Third Edition. New York, NY: McGraw-Hill Publishing Company, 1971.

Guinan, P. J., and Bostrom, R. P. "Development of Computer-Based Information Systems: A Communication Framework." *Data Base*, Vol. 17, No. 3, Spring 1986 (pp. 3-15)

Hanson, S. J., and Rosinski, R. R. "Programmer Perceptions of Productivity and Programming Tools." *Communications of the ACM*, Vol. 28, No. 2, February 1985 (pp. 180-189).

Hartog, C., and Herbert, M. "1985 Opinion Survey of MIS Managers: Key Issues." *MIS Quarterly*, December 1986 (pp. 351-361).

Hill, R. J. "A Note on Inconsistency in Paired Comparison Judgments." *American Sociological Review*, Vol. 18, No. 5, 1953, pp. 564-566.

Hoffnagle, G. F., and Beregi, W. E. "Automating the Software Development Process." *IBM Systems Journal*, Vol. 24, No. 2, 1985.

Jones, T. C. "Measuring Programming Quality and Productivity." *IBM Systems Journal*, Vol. 17, No. 1, 1978, pp. 39-63.

Jones, T. C. "The Costs and Value of CASE." In E. Chikofsky (ed), *Advance Papers for the First International Workshop on Computer-Aided Software Engineering*, Vols. 1 and 2, May 27-29, 1987, Cambridge, Massachusetts, pp. 175-176.

Kendall, M. G. *Rank Correlation Methods*, Third Edition. London, England: Charles Griffin & Company Limited, 1962.

Konsynski, B. R. "Advances in Information System Design." *Journal of Management Information Systems*, Vol. 1, No. 3, Winter 1984/85. pp. 5-32.

Konsynski, B. R.; Kotteman, J. E.; Nunamaker, J. F., Jr.; and Stott, J. W. "PLEXSYS-84: An Integrated Development Environment for Information Systems." *Journal of Management Information Systems*, Vol. 1, No. 3, Winter 1984/85, pp. 64-104.

McLean, E. R. "End Users As Application Developers." *MIS Quarterly*, December 1979, pp. 37-46.

Newman, P. S. "Towards an Integrated Development Environment." *IBM Systems Journal*, Vol. 21, No. 1, 1982, pp. 81-107.

Norman, R. J. "Integrated Development Environments in Support of Information Systems Design Methodologies and Systems Analysts' Productivity." Unpublished Ph.D. Dissertation, University of Arizona 1987.

Nowaczyk, R. H. "The Relationship of Problem-Solving Ability and Course Performance among Novice Programmers." *International Journal of Man-Machine Studies*, Vol. 21, 1984, pp. 149-160.

Suydam, W. "CASE Makes Strides Toward Automated Software Development." *Computer Design*, Vol. 26, No. 1, January 1, 1987, pp. 49-58.

Teichroew, D. "Problem Statement Analysis: Requirements or the Problem Statement Analyzer (PSA)." In J. D. Couger and R. W. Knapp, *Systems Analysis Techniques*, New York: John Wiley & Sons, Inc., 1974.

Thadhani, A. J. "Factors Affecting Programmer Productivity During Application Development." *IBM Systems Journal*, Vol. 23, No. 1, 1984, pp. 19-35.

Vitalari, N. P. "An Investigation of the Problem Solving Behavior of Systems Analysts." Unpublished Ph.D. Dissertation, University of Minnesota, 1981.

Vitalari, N. P. "Knowledge as a Basis for Expertise in Systems Analysis: An Empirical Study." *MIS Quarterly*, September 1985, pp. 221-241.

Vitalari, N. P., and Dickson, G. W. "Problem Solving for Effective Systems Analysis: An Experimental Exploration." *Communications of the ACM*, November 1983, pp. 948-956.

Ward, P. T. *Systems Development Without Pain*. New York, NY: Yourdon Press, 1984.

Wasserman, A. J. "The Future of Programming." *Communications of the ACM*, Vol. 25, No. 3, March 1982.

Wiedenbeck, S. "Novice/Expert Differences in Programming Skills." *International Journal of Man-Machine Studies*, Vol. 23, 1985, pp. 383-390.

APPENDIX A

LIST OF STIMULUS ITEM DEFINITIONS

Stimulus*	Definition
1	Graph Analysis helps you verify the design of a project by producing reports on your graphs.
2	Entity List lets you create or modify lists of entities that are used to analyze the contents of the project dictionary.
3	Report Writer lets you produce customized reports on the project dictionary.
4	The central repository for all definitions and data, and also the clearinghouse for all of the information that is associated with a given project.
5	Representation of the flow of data through a system showing the external entities that are sources or destinations of data, the processes that transform data, and the places where data is stored.
6	A top-down technique that illustrates the data model using data and relationship objects that are connected together.
7	The advantage it is to have Excelerator not only operational on a PC but also operational on a mainframe computer.
8	The ability to export information to or import information from another PC or host (mainframe) computer that may have the same or a different CASE tool operating on it.
9	The ability for Excelerator to be supported on Local Area Networks.
10	A graphical representation of data entities, illustrated by ovals, and the relationships among them, illustrated by connections. The conventions used for the connections generally follow Bachman methodology.
11	A graph type that is used primarily for overview presentations. It features a variety of objects and drawing commands.
12	The Excelerator tool plays a role in the communication process between all team members.
13	The Excelerator tool enhances an organization's efforts to enforce project standardization.
14	The ability to generate program language source code record layouts for record definitions in the project data dictionary.
15	The facility that lets you create or modify screens and/or reports that may become part of the information system being analyzed and designed.
16	Representation of the modular hierarchy within a system. This graph uses decision diamonds to show the location of function objects, data and control flow symbols to show communication between functions, and loop symbols to show repetition.
17	Representations of hierarchical logic flow using Jackson Structured Programming (JSP) symbols. Separate indicators for sequence, selection, and iteration logic are supported.

*** Stimulus List**

1 Analysis → Graph Analysis
2 Analysis → Entity List
3 Analysis → Report Writer
4 Data Dictionary
5 Data Flow Diagram (Gane & Sarson, Yourdon)
6 Entity/relationship data model (Chen or Merise)
7 Excelerator works on both PC and mainframe
8 Import and/or Export Facility
9 LAN support
10 Logical Data Model diagram (IBM)
11 Presentation Graphics
12 Project member's communication via Excelerator
13 Project standardization
14 Record Layout Generation
15 Screen/Report Design
16 Structure Charts (Constantine)
17 Structure Diagrams (Jackson)