LINEAR/NONLINEAR/STATISTICAL MODELING FOR COMPUTER-AIDED ENGINEERING OF MICROWAVE INTEGRATED CIRCUITS

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1. Market Analysis

Market Segmentation

A. Type of Product

The product will meet the need for modeling and design of microwave integrated circuits. It will have a vital role in characterization and modeling of the key device used both in packaged devices and in chip manufacture, namely, the transistor itself. The product will substantially improve cost effectiveness and affordability in the manufacture of receive/transmit circuits.

The product will be created in the context of OSA's long term plan to serve the microwave industry's needs for fast, accurate and user-friendly software systems capable of designing integrated circuits in new technologies for the 1990s.

B. Type of Customer

The product is designed to serve those larger corporations who have substantial manufacturing capabilities in the defence and communications market. It will also serve smaller corporations with a high volume of specialized products in the microwave, radar, communications and defence industry.

C. Customer Location

Canada The primary market in Canada is located in Montreal, Ottawa and Toronto. OSA is well positioned to serve these clients.

U.S.A. The primary United States locations are the Boston, Los Angeles and San Francisco areas. Secondary locations are in Texas and Florida.

Europe Britain and West Germany are expected to be the primary areas, followed by Italy, Benelux, Scandinavia and France.

Japan

D. Price

North American price is expected to be US $30,000.00. Europe will be 20% higher and Japan 50% higher.

Size of Market

It is expected that 33 units will be sold in the first two years after release.

Growth Rates

Because of OSA's plans to continually enhance its products it is expected that the primary clients will purchase enhancements as released along with accompanying maintenance options.

As the industry is close knit word of mouth group sales are expected to increase in subsequent years at a 10% growth rate.

Access to Market

It is expected that approximately 10 corporations worldwide will purchase the product through their policy of acquiring one of every major high technology software innovation.

Distribution

The product will be directly distributed by OSA.

Product/Market Evolution

This is very much a niche product, highly needed. It will be the first of its kind in the world. We expect OSA to capture the market.

There is no software commercially available for statistical FET modeling for analog microwave applications. Our achievements in the proposed research will contribute, therefore, towards OSA's advantage over other software companies.

The main CAD software systems offered to the microwave industry, currently Super-Compact, Microwave Harmonica, Touchstone and Libra are gearing towards design centering and yield optimization features. The need for reliable device statistical models and software tools to create such models has become obvious to design engineers and management. OSA will take advantage of this expanded market. New technological developments and customer feedback will be used to upgrade the product in order to meet future needs of the industry as well as to attract more customers.

Market Trends

A. Potential Entrants

The market for software in device modeling for CAD of microwave integrated circuits is addressed by: TECAP distributed by Hewlett-Packard; Xtract produced by EEsof; Utmost produced by Silvaco; **HarPE™** produced by OSA. These products, with the exception of **HarPE™**, are imported from the United States.

B. Pricing

Future developments by EEsof are considered to be potentially the most competitive. In particular we will closely follow enhancements of EEsof's Xtract, currently priced at US $ 34,500.00. Their product is a first entry into the field and meets a more generic need. OSA's product moves into the next generation of device modeling tools.

C. Product Capabilities

Products currently available for microwave device modeling (with the exception of OSA's **HarPE™**) primarily solve for FETs with direct current (DC) and/or small-signal measurements. **HarPE™** is the world's first commercial product for FET modeling within a true nonlinear environment. Introducing statistical data and the ability to model for volume production will be another world's first.

Market Characteristics

A. The Major Market Influence

The greatest impact on the market will be made in conjunction with the IEEE MTT-S International Microwave Symposium and Exhibition held annually in May or June. It is usually located in a significant geographical area. In 1989 it is held in the Los Angeles area, combined with the Microwave and Millimeter-Wave Monolithic Circuits Symposium and the Automatic RF Techniques Group Conference. This will attract several thousand professional engineers, a large fraction of the world's microwave engineers. Virtually every company, world wide, is represented at these meetings. In 1990 it will be in Dallas, Texas. There, it will be augmented by two closely related groups: The IEEE Antennas and Propagation Society and the National Radio Science Meeting (URSI) will combine their meetings. Some 20,000 IEEE engineers are represented by these organizations. In 1991 it will be in Boston, Massachusetts, one of the major areas of concentration of microwave research, design and manufacturing.

B. Brand Loyalty and Barriers to Entrance

EEsof has developed a significant customer loyalty. Our strength in penetrating their market relies upon two important strategies. (1) Our product will be made as compatible as possible with EEsof's so that our products will be complementary. (2) Approximately 30% of our sales will come from companies whose software inventory and budget makes possible the acquisition of a copy of every major software product. Technical superiority and compatibility with competitors' products are a fundamental element in OSA's designs.

Sensitivity of Demand

A. Price

US $5,000 At this price a CAD product is generally affordable and is likely to be within the budget control of a typical engineer. At this price we would expect 100 units to be sold. Expected Sales: US $500,000.

US $10,000 Some managerial approval required. At this price we would expect 70 units to be sold. Expected Sales: US $700,000.

US $20,000 At this price a CAD product is likely require a high level of approval by management. At this price we would expect 40 units to be sold. Expected Sales: US $800,000.

US $30,000 The product would have to offer unique capabilities. Some market resistance expected. Large companies are expected to buy at this price. We would expect 33 units to be sold. Expected Sales: US $990,000.

US $40,000 Considerable resistance by the market is expected at this price. Even large companies would consider such an acquisition very carefully. At this price we would expect 10 units to be sold. Expected Sales: US $400,000.

We conclude from the foregoing analysis that US $30,000 is optimum.

B. Service

OSA will provide a one year maintenance contract to customer, included in the purchase price. A high degree of reliability, technical competence and skill within OSA guarantees service to our customers.

C. Product Features

The ease with which the customer can acquire the skill to make use of the product is crucial to product acceptance. Menu-driven user-friendly interaction will be available through very simple key strokes, allowing self paced, self directed learning to the user.

D. External Factors

Success of the microwave industry in the present manufacture of monolithic microwave integrated circuits will affect the demand for this software. It has been estimated by Naegele in Electronics, November 1987, that the world wide market in 1997 for GaAs analog integrated circuits will be in the region of US $1.8 billion.

With this rapid development in monolithic microwave integrated circuit technologies, the demand for fast and accurate software systems as created by OSA will be stimulated.

2. Target Markets

Major Segments

The market consists of manufacturers of high frequency analog devices and circuits, and research laboratories working with analog circuits requiring advanced CAE tools. Of particular importance are companies planning manufacturing activities in monolithic microwave integrated circuits. Such companies will have new requirements beyond the capabilities of existing products, but consistent with OSA's innovations.

The market has been divided into 3 segments: (1) companies already familiar with OSA's level of competence in CAD technology, (2) companies committed to advanced CAD technology, and (3) the remaining microwave companies.

A. Companies Familiar With OSA's Competence

The following companies will first acquire OSA's product. Personal and direct contact should suffice in promoting the product.

Canada	Bell-Northern Research
	BEL-TRONICS
	ComDev
	Communications Research Centre
	Microtel Pacific Research
	Mitec Electronics
	Northern Telecom
	Quantic Laboratories
	Spar Aerospace

USA	Avantek
	Cascade Microtech
	Ford Aerospace
	General Dynamics
	General Electric
	Hughes Aircraft
	Martin Marietta Orlando Aerospace
	Raytheon
	Sandia National Laboratories
	Texas Instruments
	TriQuint Semiconductor
	TRW
Other	British Aerospace
	British Telecom Research Laboratories
	Bussan Electronic Systems Technology
	Filtronic Components
	Marconi
	Nippon Electric Company
	Plessey
	Siemens
	Sony
	Thomson Hybrides et Microondes

B. Companies Committed to Advanced CAD Technology

The companies in this category are generally known to us, but they will have to be convinced that the product is to their advantage. Direct mail, personal visits and demonstrations will be given to them.

Canada	Andrew Antenna
	Gennum Corporation
	MA Electronics Canada
	Mitec Electronics Ltd.
USA	AT&T Bell Laboratories
	Comsat Laboratories
	David Sarnoff Research Center
	Deskin Research Group
	Du Pont
	Gamma-f Corp.
	Gazelle Microcircuits
	Hewlett-Packard
	IBM
	M/A-COM
	Menlo Industries
	Microwave Associates
	NYNEX Corporation
	Sandia National Laboratories
	Satellite Technology Service
	Stanford Electronics Laboratories
	Tektronix

Teledyne Microwave
U.S. Army Electronics Command
United States Air Force
Watkins-Johnson
Westinghouse

C. The Remaining Microwave Companies

The companies in the third category will be targeted through advertising in trade journals and at international conferences and exhibitions.

3. Competitor Evaluation

Competitor Product Line

None of the existing software products in the microwave CAE arena addresses the subject of statistical modeling of active devices. The potential competitors, however, are aware of the needs in this area.

Comparison with Competition

We estimate that we have an 18 month lead over possible competition. This is based on our knowledge of the state of the art, our capabilities and our insight into the technical capabilities of the people involved in the competition. OSA is at the leading edge of microwave CAD technology. We are confident in our assessment of the competition.

We cannot rule out the possibility that Compact Software, EEsof, or another company will initiate their own product of the proposed type. A competitor may also be interested in purchasing rights to market the product.

4. Marketing and Distribution

Marketing Scheduling

See Table I for development, maintenance and marketing schedule during the last six months of research and development, and the first six months after product release.

Marketing Strategy

To ensure OSA's success, we are expanding technical cooperation with the microwave industry. We are continuing our high-level research to retain our image and leading position in technical areas. Our effort in advanced parameter extraction software contributes to the establishment of our influence and credibility in the market.

We will exploit our past success in providing the highest state-of the art contributions to microwave CAD technology, emphasizing our key role in the Raytheon/Texas Instruments Joint Venture into the US Department of Defense MIMIC Program. **OSA is the only non-US group participating in the Department of Defense's $300 million program.**

The MIMIC Program is of predominating interest at international meetings. OSA's role is frequently emphasized.

The main reason to acquire the OSA product will be the technical capabilities which meet the industry's demands. For customers the features in our product will directly translate into more economical manufacturing, allowing the product to pay for itself rapidly. We believe that OSA's penetration of the marketplace and its positive feedback will create incentive for the remaining sector of the market to acquire OSA's products. The nature of the marketplace is such that users of existing CAE tools will not let their competitors have an edge with better CAE tools (OSA's product), and hence, will be motivated to acquire the same software. We forecast that the major share of this potential market will be captured by OSA.

Distribution

Distribution will be by direct mail and express courier from OSA. The software will be on diskettes or cartridge tapes, accompanied by manuals.

Promotion

Direct mail advertising to several thousand IEEE members who are also microwave engineers will be undertaken. Technical product summaries will be sent to all potential customers.

Contacts in industry will assist in arranging on-site seminars and demonstrations in various companies.

Press releases, product announcements, product feature articles and full page colour advertisements will be sent to various trade journals including:

Microwave and RF Engineering
Microwave Journal
Microwaves & RF
MSN and Communications Technology

Appropriate announcements will also be sent to the following nonspecialist magazines:

Canadian Research
Electronics

Booths will be reserved at exhibitions held in conjunction with appropriate conferences, including:

European Microwave Conference
GaAs IC Symposium
IEEE MTT-S International Microwave Symposium
MIOP
Technologie des Hyperfrequences

Demonstration versions of the product will be made available to the most prestigious and influential customers. We will cooperate with industrial and government laboratories, to explore ways of including their device models and fabrication statistics in our software and to ensure compatibility with their own hardware/software.

Detailed brochures and product summaries will be sent to the previously identified target market.

5. Financial Projections

There is no commercially available software for statistical FET modeling for analog microwave applications. Therefore, our achievements in the proposed research will contribute towards OSA's advantage over other software companies. We feel we have a lead of about 18 months over competition in this area.

The final product will cost US $30,000 per copy, and an annual maintenance fee of 20% of the current price will be charged from the second year. Within the first two years after release we expect a sale of 3 to 5 copies in Canada and of 30 to 50 copies outside Canada.

Income Statement for Project (Year 1)

Revenue from Direct Sales (16 @ US $30,000.00 @ 1.2)	$576,000.00
Revenue from Maintenance Agreements	0.00
Direct Costs	$3,200.00
Gross Margin	$572,800.00
Expenses:	
Advertising	$30,000.00
Demonstrations	$20,000.00
Manpower	$135,000.00
Overhead	$135,000.00
Research & Development Costs	$190,000.00
Profit	$62,800.00

Income Statement for Project (Year 2)

Revenue form Direct Sales (17 @ US $30,000.00 @ 1.2)	$612,000.00
Revenue form Maintenance Agreement	$115,200.00
Direct Costs	$3,400.00
Gross Margin	$723,800.00
Expenses:	
Advertising	$40,000.00
Demonstrations	$30,000.00
Manpower	$148,500.00
Overhead	$148,500.00
Profit	$356,800.00

TABLE I
BAR CHART FOR PRODUCT DEVELOPMENT AND MARKETING
DURING THE LAST SIX MONTHS OF R&D
AND THE FIRST SIX AFTER PRODUCT RELEASE

Item Description	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Product Development												
Product Upgrading												
Customer Service												
Product Maintenance												
Segment A Marketing												
Segment B Marketing												
Segment C Marketing												
Advertising												
Demonstrations												