NUMERICAL TECHNOLOGIES INC
Form 10-K
February 19, 2002

SECURITIES AND EXCHANGE COMMISSION

WASHINGTON, DC 20549

FORM 10-K

(Mark One)

x **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934 FOR THE FISCAL YEAR ENDED DECEMBER 31, 2001**

OR

¨ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934 FOR THE TRANSITION PERIOD FROM TO**

Commission file number: 000-30005

NUMERICAL TECHNOLOGIES, INC.

(Exact Name of Registrant as Specified in Its Charter)

Delaware **(State or Other Jurisdiction of Incorporation or Organization)**	**94-3232104** **(I.R.S. Employer Identification Number)**
70 West Plumeria Drive **San Jose, California** **(Address of Principal Executive Offices)**	**95134-2134** **(Zip Code)**

Registrant s Telephone Number, Including Area Code:
(408) 919-1910

Securities registered pursuant to Section 12(g) of the Act:
Common Stock, par value $0.0001 per share.

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes x No ¨

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of registrant s knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ¨

Aggregate market value of the voting common stock held by nonaffiliates of the registrant as of January 31, 2002: $357,318,646

Number of shares outstanding of the registrant s common stock, $0.0001 par value, as of January 31, 2002: 33,640,097

DOCUMENTS INCORPORATED BY REFERENCE:

Portions of the definitive Proxy Statement for Numerical Technologies, Inc. s Annual Meeting of Stockholders to be held on May 15, 2002 are incorporated by reference into Part III of this Form 10-K.

NUMERICAL TECHNOLOGIES, INC.

Form 10-K Annual Report
For the Fiscal Year Ended December 31, 2001

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UNLESS OTHERWISE INDICATED, REFERENCES TO COMPANY MEAN NUMERICAL TECHNOLOGIES, INC. AND ITS SUBSIDIARIES.

Certain information contained or incorporated by reference in this Annual Report on Form 10-K is forward-looking in nature. All statements included or incorporated by reference in this Annual Report on Form 10-K or made by management of Numerical Technologies, Inc. and its subsidiaries (collectively, Numerical , except as otherwise set forth herein), other than statements of historical fact, are forward-looking statements. Examples of forward-looking statements include statements regarding Numerical s future financial results, operating results, business strategies, projected costs, products, competitive positions and plans and objectives of management for future operations. In some cases, forward-looking statements can be identified by terminology such as may, will, should, would, expects, plans, anticipates, believes, estimates, predicts, potential, continue, or the negative of these terms or other comparable terminology. Any expectations based on these forward-looking statements are subject to risks and uncertainties and other important factors, including without limitation those discussed in the section entitled Item 7: Management s Discussion and Analysis Trends, Risks and Uncertainties . These and many other factors could affect Numerical s future financial and operating results, and could cause actual results to differ materially from current expectations.

PART I

Item 1: Business

We are a leading commercial provider of proprietary technologies and software products that enable the design and manufacture of subwavelength semiconductors. We offer a comprehensive solution that enables the production of smaller, faster and cheaper semiconductors using current generation equipment. We believe this solution enables our customers and industry partners to realize increased return-on-investment, and deliver new high-performance semiconductors more quickly than other commercially viable solutions.

Our patented phase-shifting technology, combined with our proprietary optical proximity correction (OPC) and process modeling technologies, form the foundation of our subwavelength solution. Our comprehensive subwavelength solution integrates these technologies into each key stage of semiconductor manufacturing to form an integrated design-to-silicon flow. We believe that our technology leadership and relationships with leading companies within the semiconductor industry will drive the adoption of our solutions as the industry standard.

We have currently licensed our proprietary technologies for production use to Intel, Fujitsu, Motorola, Texas Instruments and United Microelectronics Corporation (UMC). MIT Lincoln Laboratories (MIT), a research facility, has demonstrated the future potential of our proprietary technologies by producing 0.009-micron features. Our other industry partners and customers include Applied Materials, Cadence, Canon, Dai Nippon Printing, DuPont Photomask, KLA-Tencor, Nikon, Photronics, Simplex, Taiwan Semiconductor Corporation (TSMC), Toshiba and Zygo.

Industry Background

Businesses and individuals increasingly rely on electronic products and systems powered by semiconductors. These products and systems include desktop and portable personal computers, mobile phones, Internet appliances, video game consoles, and high-speed networking and communications products that serve as the backbone of the Internet. Growing recognition of the benefits of advances in electronics, including enhanced productivity and communications capability, drives demand for higher performance, lower cost, smaller and more power efficient products with greater functionality. To meet this demand, manufacturers of electronic products and systems require an increasing supply of faster, cheaper and more power efficient semiconductors. The Semiconductor Industry Association estimated, in its November 2001 report, that the worldwide market for semiconductors will grow from $141 billion in 2001 to $218 billion in 2004, or 55%. Delivering these advanced semiconductors will require rapid advances in integrated circuit (IC) design and manufacturing technologies.

The Historical March to Smaller Feature Sizes and Systems-on-a-Chip

The ability to produce advanced ICs depends on developing technology that enables the design and manufacture of semiconductors with smaller feature sizes. A semiconductor s feature size relates to the size of circuit components in the device and is measured in microns, or millionths of a meter. Advanced semiconductors today have feature sizes of 0.07 to 0.13 micron. To illustrate how small these features are, when placed side by side, one thousand 0.10 micron transistors can fit within the width of a single human hair. Smaller feature sizes significantly increase performance while decreasing the size, cost and power consumption of semiconductors. Smaller feature sizes also allow multiple components, such as microprocessors, memory, analog components and digital signal processors, to be integrated into a single semiconductor. The resulting complex semiconductor, commonly referred to as system-on-a-chip, offers significant performance, cost, power and reliability benefits over systems that require multiple semiconductors to perform the same tasks.

Advances in semiconductor design and manufacturing technologies enabled reductions in feature sizes from 3.0 micron in 1980 to 0.07 micron and smaller in today s advanced production fabrication facilities. These advances led to significant improvements in electronic systems and products. For example, today s cellular phones compared to those of a few years ago have a battery life of days instead of hours, weigh ounces instead of pounds and can be produced at a fraction of the price. In addition, today s cellular phones have many times the computing power of the most advanced personal computer in 1980.

To date, the semiconductor industry relied upon advances in semiconductor equipment to produce smaller feature sizes on semiconductors. However, to fully realize the benefits of smaller feature sizes, significant advances have also been required in each of the following key stages of the semiconductor design-to-silicon flow:

Semiconductor Design Tools. A variety of complex software programs used to design, simulate and verify semiconductor designs.

Photomasks. Templates used to transfer images of electronic circuits to silicon wafers.

Semiconductor Equipment. Sophisticated equipment used to manufacture semiconductors.

Semiconductor Manufacturing. Complex processes required to create semiconductors on silicon.

Historically, leading semiconductor companies designed, manufactured and tested their semiconductors in their own facilities using internally developed tools. The growing complexity of the design and manufacturing processes and the escalating cost of manufacturing facilities resulted in a disaggregation of the semiconductor industry into companies separately focusing on each individual stage of the design-to-silicon flow. This disaggregation is fueling the rapid growth of fabless semiconductor companies, which do not own or operate their own semiconductor fabrication facilities, design tool vendors, semiconductor equipment manufacturers and third-party semiconductor manufacturers, or foundries. Each of these industry markets faces significant challenges as feature sizes continue to decrease.

The Subwavelength Challenge

Semiconductor manufacturing equipment transmits light at a specific wavelength through a photomask to create images of IC patterns on a semiconductor. This process is referred to as photolithography or optical lithography. At feature sizes below 0.25 micron, the semiconductor industry reached a critical technology transition. At and above 0.25 micron, the wavelength of light used is smaller than the IC features. However, at 0.18 micron and below, the wavelength of light used in production semiconductor manufacturing equipment is significantly larger than the IC features, resulting in image quality that degrades rapidly. This is like trying to paint a one-inch line with a four-inch paintbrush. This growing disparity between feature sizes and wavelength of light is referred to as the subwavelength gap. As a result, manufacturers in the industry cannot produce semiconductors with feature sizes of 0.18 micron and smaller with acceptable yield levels using traditional technologies. Furthermore, as the demand for reduced feature sizes continues to outpace the reduction in wavelengths used by available equipment, this subwavelength gap will widen.

In its 2001 International Technology Roadmap, the Semiconductor Industry Association predicted that the semiconductor industry would introduce microprocessors with 0.053 micron feature sizes for semiconductors by the end of 2002 and 0.070 micron random access memory chips, or DRAM, by the end of 2006. Advances in manufacturing equipment technology alone can no longer enable the progression to smaller feature sizes and we do not expect alternative, non-optical manufacturing processes to be commercially viable for many years. As a result, the semiconductor industry must develop and integrate new subwavelength solutions into all aspects of the design-to-silicon flow.

Our Solution

We are a leading commercial provider of proprietary technologies and software products that enable the design and manufacture of subwavelength semiconductors using existing design tools and semiconductor equipment. We know of no other commercially proven technology that can be used for volume production of semiconductors with feature sizes of .07 micron. Our comprehensive solution addresses each key stage of the design-to-silicon flow, including physical design, design verification, manufacturing data preparation, photomask manufacturing inspection and photolithography. By offering a subwavelength solution that is used in every stage of the semiconductor design and manufacturing process, we integrate the entire design-to-silicon flow for subwavelength ICs.

Our patented phase shifting and proprietary OPC and process modeling technologies serve as the foundation for our subwavelength solution. Our subwavelength solution leverages our expertise in semiconductor and photomask manufacturing processes, semiconductor equipment, IC design, software development and subwavelength technologies.

Our proprietary technologies and software products are designed to offer the following key benefits:

Proven Path to Smaller, Faster, Cheaper and Power Efficient Devices. Our industry partners and customers have demonstrated the success of our proprietary technologies and software products. For example, Motorola used our phase shifting technology and software to enable its 0.18 micron wafer fabrication facilities to produce 0.10 micron features. In January 2001, UMC announced plans to use our phase shifting technology for the production of 0.07 features. In April 2001, Intel licensed the rights to use our patented phase shifting technology in production. In May 2001, Fujitsu licensed the rights to use our patented technology in production. Further, in March 2001, MIT, a research facility, demonstrated the future potential of our technologies and products by successfully creating 0.009 micron features. MIT used our phase shifting technology and standard 0.25 micron semiconductor manufacturing equipment.

Accelerate Time to Market. In today s economy, semiconductor manufacturers can achieve a significant market advantage by being the first to introduce more advanced semiconductors. Introducing next generation semiconductors has historically required the semiconductor industry to install new equipment or to construct new manufacturing facilities, which may take up to three years to complete. Our phase shifting technology and software products enable companies to use existing equipment to produce smaller, faster and more power efficient semiconductors, thereby enabling them to introduce new products more rapidly.

Increase Return on Capital Equipment Investment. We design our proprietary technologies and software products to enable existing semiconductor manufacturing equipment to produce subwavelength ICs. Using our technologies and products, semiconductor manufacturers will not be required to spend up to billions of dollars to produce ICs with smaller and smaller feature sizes. As a result, these semiconductor manufacturers can significantly increase their return on invested capital. Furthermore, we believe that the use of our proprietary technologies and software products results in higher manufacturing yields.

Integrate the Key Stages of the Design-to-Silicon Flow. We design our proprietary technologies and software products on a common platform and architecture, which are implemented in key stages of the design-to-silicon flow. Our software products utilize a common process modeling and simulation technique that allows the tools and equipment used in subsequent stages to understand and process the results generated by each of the prior stages. For example, the separate tools and equipment used to design, verify and manufacture semiconductors can coordinate with each other to ensure an accurate design-to-silicon flow. This coordination is particularly critical in the semiconductor industry, which has disaggregated into different companies that specialize in separate key stages of the design-to-silicon flow. We believe this is necessary to the successful production of subwavelength semiconductors.

Our Strategy

Our objective is to establish our proprietary technologies and software products as the industry standard for the design and manufacture of subwavelength semiconductors. Key elements of our strategy include the following:

- Drive Continued Adoption of Our Subwavelength Solution
- Expand Relationships with Our Industry Partners
- Leverage Our Comprehensive Platform
- Leverage Our Market Position in Manufacturing Data Preparation Products
- Leverage Our Market Position in Standard Cell Layout Creation
- Integrate Subwavelength Technology into the Design Automation Flow
- Extend Technology Leadership Position
- Maintain Time-Based Software and Intellectual Property Licensing Models

Drive Continued Adoption of Our Subwavelength Solution. We seek to proliferate our proprietary technologies and software products as the solution to the subwavelength gap problem. As part of this strategy, we intend to continue to expand our relationships with leading integrated device manufacturers, or IDMs, such as Motorola and Texas Instruments, and leading foundries such as TSMC and UMC. Due to the increasing proportion of semiconductors manufactured at foundries, we intend to increasingly focus our efforts on establishing our patented phase shifting technologies as the standard at TSMC, UMC and other foundries to further drive the adoption of our subwavelength solution by each of the other participants in the design-to-silicon flow. We believe that semiconductor manufacturers, including IDMs and foundries, must first adopt our proprietary technologies in order to drive adoption of our technologies by the other participants within the design-to-silicon flow. If these manufacturers do not perceive our proprietary technologies and software products as a viable solution to the subwavelength gap problem, our technologies and products may become more difficult to license to such manufacturers and this may limit the adoption of our subwavelength solution by the other participants in the design-to-silicon flow.

Expand Relationships with Our Industry Partners. We intend to strengthen and expand our industry partner relationships with the leading companies within each stage of the design-to-silicon flow. To date, we have developed relationships with semiconductor design tool vendors such as Cadence and Simplex, photomask manufacturers such as Dupont Photomask, Dai Nippon Printing and Photronics, and semiconductor equipment manufacturers such as Applied Materials, KLA-Tencor and Zygo. We believe that these broad-based industry relationships will help to proliferate our proprietary technologies and software products as the industry standard. We must expend significant management, sales and our other limited resources in order to expand and strengthen these relationships. Our ability to successfully do so is dependent upon our industry partners not developing their own solutions to the subwavelength gap problem, or our competitors offering better terms or pricing conditions to our industry partners.

Leverage Our Comprehensive Platform. We intend to leverage the common platform of our proprietary technologies and software products to aggressively market our products to each key market in the semiconductor industry. This common platform enables data and information regarding subwavelength designs to be shared by participants in each key stage of the design-to-silicon flow. Because our proprietary technologies and software products ensure the accurate and consistent communication of subwavelength design and process data, each participant in the design-to-silicon flow benefits from their use. In order for us to be successful in aggressively marketing our technologies and products to each key market of the design-to-silicon flow, we must continue to ensure that we design such technologies and products so that each key market can work efficiently with the other markets.

Leverage Our Market Position in Manufacturing Data Preparation Products. The vast majority of semiconductor, photomask and semiconductor equipment manufacturers and foundries use our manufacturing data preparation software as the essential link between the design and production stages of the design-to-silicon flow. We intend to build on this market position in manufacturing data preparation to market our subwavelength proprietary technologies and software products to these customers. Our manufacturing data preparation software competes with current and future products in this stage of the design-to-silicon flow. We may need to take various steps, including without limitation reducing prices, in order to remain competitive in the market for mask data preparation software.

Leverage Our Market Position in Standard Cell Layout Creation. We intend to strengthen and continue to build upon our position as the leading provider of automated layout creation technology for standard cell libraries used in semi-custom, and custom integrated circuits (ICs). Cell layouts are the primary means of transferring information about new process technology to the design flow. We believe the layout creation capability coupled with our subwavelength technologies will speed the mainstream adoption of our phase-shifting technology by the semiconductor industry.

Integrate Our Subwavelength Technologies into the Design Automation Flow. Through our acquisition of Cadabra Design, we acquired one of the most widely used solutions for the automated creation of the layouts for standard cells required for IC design. These cells communicate process information to automated design tools. We intend to integrate our proprietary technologies into the Cadabra solution in order to offer design teams fast access to the processes that incorporate our subwavelength technologies. In order to be successful in integrating our proprietary technologies with the Cadabra solution, we must focus our research and development efforts in order for the integrated solution to function correctly and efficiently. We must also focus our sales and marketing efforts to emphasize to semiconductor manufacturers the benefits of purchasing this integrated solution.

Extend Technology Leadership Position. We believe we were among the first to recognize that the subwavelength gap would represent a significant challenge to continued advances in semiconductor technology. To capitalize on this business opportunity, we engaged in significant research and development activities over the past six years, pioneering manufacturable phase shifting technologies that we believe are the key to bridging the subwavelength gap. We assembled a strong team of subwavelength experts, many of whom have graduate technical degrees, and we intend to continue expanding our research and development efforts to further enhance our proprietary technologies.

Maintain Time-Based Software and Intellectual Property Licensing Models. Our business model allows us to build on the sales and marketing efforts of our industry partners, which resell, market and promote our technologies and products. We seek to generate the majority of our future revenue through time-based license fees, intellectual property licensing agreements and other innovative, ongoing agreements with IDMs, foundries and reseller licensees. Our ability to generate this revenue depends on industry acceptance of such agreements and licensing models as well as our ability to protect our proprietary technologies.

Technology

As feature sizes decreased to dimensions smaller than the wavelength of light used in optical lithography equipment, phase shifting and OPC technologies became critical to the continued growth of the semiconductor industry. Widespread deployment of subwavelength technologies requires the industry to create an efficient and integrated IC design and manufacturing process and to introduce new technologies into several stages of the design-to-silicon flow. Our proprietary technologies and software products allow IC designers, as well as manufacturers of photomasks, semiconductor equipment and semiconductor devices, to successfully deploy phase shifting and OPC technologies. We believe we are the only company exclusively focused on delivering a comprehensive solution that enables the design and manufacture of subwavelength ICs.

Phase Shifting

The foundation of our subwavelength process technologies lies in our phase shifting technology, which manipulates light waves to produce high-resolution images of subwavelength IC features. Our phase shifting technology sequences positive and negative light wave patterns to prevent interfering waves from causing the image on silicon to blur or disappear entirely. This enables designers and manufacturers to create IC features that are less than half the size of those that can be produced using conventional optical lithography techniques. Our phase shifting technology also dramatically reduces sensitivity to variations in the manufacturing process such as focus deviations and lens imperfections, significantly improving manufacturing yields. We developed the industry s first production-worthy, commercial phase shifting technology by combining the multidisciplinary expertise of our scientists and engineers and investing significantly in joint research and development activities with leading photomask and semiconductor manufacturers.

Optical Proximity Correction

Our OPC technologies embed corrective features in the IC design and photomask to reduce image distortions caused by interfering light waves. We developed these technologies in close collaboration with photomask and semiconductor manufacturers to improve photomask manufacturability without sacrificing performance. Our OPC technologies focus on correcting distortions in semiconductor features that would most affect the semiconductor s performance. OPC makes it possible to obtain an IC pattern that more closely resembles the original desired design. However, as feature sizes continue to decrease, OPC is no longer sufficient to ensure acceptable manufacturing yields. At these smaller feature sizes, semiconductor manufacturers will employ both OPC and phase shifting process technologies.

Process Modeling and Simulation

Historically, the designed layout of a semiconductor, its representation on the photomask and the corresponding features on the semiconductor were essentially identical. At subwavelength feature sizes, this relationship no longer exists. As a result of distortions created during the manufacturing process and the application of phase shifting and OPC, the design of a semiconductor, its representation on the photomask and the pattern transferred to the semiconductor all look different. We developed proprietary process modeling and simulation technologies that recharacterize the relationship between device design, photomask pattern and semiconductor features. This recharacterized relationship allows designers and manufacturers to more accurately translate designs and photomasks to final semiconductors. Semiconductor manufacturers can calibrate our process models to more accurately characterize their specific processes and use them in our software products throughout the design-to-silicon flow. Manufacturers can use a common process model throughout the design-to-silicon flow to facilitate consistency in the communication of process and design data.

Automated Transistor Layout (ATL)

In the process of designing ICs, it is very important to effectively and automatically communicate process requirements into the IC design flow. Traditionally, this has been done through a library of cells for IC designs. These libraries have, in the past, been created through an intensive, manual process. With the advent of subwavelength processes, however, the design of libraries becomes much more complex. Phase shifting information and OPC effects must be considered in the library design process. Through our acquisition of Cadabra, we offer technology that automates the creation of layouts of these cells, saving both time and engineering resources.

Implementation Technologies

We developed or acquired several technologies necessary to implement the mainstream design and manufacturing use of phase shifting and OPC technologies. These include:

- design automation algorithms for phase shifting and OPC;
- hierarchical design data management technologies;
- subwavelength design verification technologies;
- photomask defect analysis technologies;
- high-performance process simulation algorithms and process model calibration technologies;
- algorithms for manufacturing data preparation; and
- algorithms to automatically create and optimize layouts of the standard cells required for IC design.

Products

We offer technology products, software products and services that together provide a comprehensive subwavelength design-to-silicon solution.

Technology Products

Phase Shifting Technology. Our phase shifting technology licenses allow the licensee to produce subwavelength semiconductor devices using our proprietary technology. We offer limited use research and development licenses that allow the licensee to use our proprietary technology for pre-production purposes. We also offer production licenses of our phase shifting technology that are time based, or are licensed per fabrication facility or per device produced.

Subwavelength Process Development. We offer a comprehensive implementation package that includes a development plan, calibration and test photomasks and on-site customer assistance to develop advanced subwavelength manufacturing processes using our phase shifting and OPC technologies and software products. Our engineers and scientists work on-site at our customers fabrication facilities to develop these processes and generate design rules, calibrated models and associated design-to-silicon flows.

Software Products

We offer a comprehensive suite of complex integrated software products that all of the key markets within the semiconductor industry can use. These markets use our software products independently or integrate them with IC design tools, and photomask and semiconductor manufacturing equipment. Our products address the needs of subwavelength design and manufacture in five key sectors of the design-to-silicon flow:

Sector	Products	Applications
Library Development	Cadabra	Automate the creation and optimization of standard cells layouts used for IC design
Physical Design and Post-Layout Data Processing	iNPhase SiVL iNTandem	Ensure compatibility of semiconductor designs with subwavelength processes Create phase shifted and OPC device design layout Verify silicon performance of designs Hybrid OPC software to enable manufacturability of semiconductor designs Generate calibrated process models and design rules for phase shift and OPC processes
Manufacturing Data Preparation and Photomask Manufacturing	CATS Photolynx	Process design data required to fabricate and inspect photomasks Verify input data, manufacturing processing and photomask layout Convert photomask design data to formats required by specific photomask manufacturing equipment Verify photomask and wafer manufacturability Hybrid OPC software integrated in a data preparation environment to enable manufacturability of semiconductor designs Optimize mask and wafer fabrication process parameters
Photomask Inspection and Measurement	Virtual Stepper i-Virtual Stepper	Characterize located photomask defects Transcribe and transfer design data to photomask and wafer inspection and measurement equipment
IC Fabrication and Process Development	IC Workbench SiVL	Optimize fabrication process parameters Verify silicon performance of designs

Each of these products is described below.

Library Development

Cadabra. Our Cadabra product line automates the creation and optimization of standard cell layouts used in IC design. These cells act as the communication vehicle for manufacturing process requirements to design tools. These Cadabra products allow us to integrate our proprietary subwavelength technologies into the design flow in a manner that is transparent to designers.

Physical Design and Post-Layout Data Processing Products

iNPhase. Our iNPhase product automates and integrates the design, verification and OPC functions of our phase shifting technology. iNPhase also verifies that the semiconductor design is free of phase conflicts, or design configurations that could result in manufacturing failures.

SiVL. Our silicon-versus-layout product utilizes our proprietary process simulation technologies to verify that conventional, phase shifting and OPC designs produce printed IC patterns within specified tolerances. By predicting silicon level failures, SiVL reduces or eliminates the need to repeat the design and manufacturing process. SiVL integrates with tools used to verify that the IC patterns are within specified tolerances.

iNTandem. Our iNTandem product automatically corrects designs for process-induced distortions or subwavelength features. iNTandem combines the application of our rule-based OPC engine with our model-based OPC engine into a Hybrid OPC use model.

Manufacturing Data Preparation and Photomask Manufacturing Products

CATS. This family of products includes products that automatically create different photomask layers by sizing and combining design layers. Our CATS products allow users to view the input and output data of the manufacturing data preparation process and verify photomask design accuracy using a combination of graphical algorithmic and query analyses. The CATS product line includes modules that automatically transcribes photomask layout data into input data formats for specific photomask manufacturing equipment. This line supports leading photomask equipment manufacturers, including Etec, Hitachi and Leica. The data is checked for variations from manufacturing requirements, including minimum widths, spacing and layer to layer errors.

Photolynx. Our Photolynx product integrates our OPC engine (available also in iNTandem) with CATS manufacturing data preparation environment to offer a combination of both our rule-based OPC technology as well as our model-based OPC technology as part of the mask data preparation step. Photolynx also includes Silicon vs. Layout verification capability to ensure mask data output produce printed IC patterns within specified tolerances. Furthermore, Photolynx includes our process simulation engine, which is used to simulate the final IC features corresponding to the mask as well as the capability to analyze and optimize IC manufacturing processes.

Photomask Inspection and Metrology Products

Virtual Stepper. This product allows photomask manufacturers to assess the impact of photomask defects on the silicon wafer. Photomask manufacturers using Virtual Stepper can determine photomask quality, improving their productivity and yield. The Stepper takes direct input from defect inspection and review equipment manufactured by leading equipment companies including Applied Materials, KLA-Tencor and Zygo.

i-Virtual Stepper. This product is the internet-enabled version of Virtual Stepper. By using i-Virtual Stepper, photomask manufacturers can determine photomask quality and improve their yield regardless of where the inspection equipment is located and regardless of where the other members of their team are located.

Semiconductor Fabrication and Process Development

IC Workbench. IC Workbench is an interactive process simulation, analysis and optimization tool. This product includes a graphical user interface, design data viewer and editor with real-time simulation feedback. This allows users to evaluate the impact of design and process parameters on the final silicon results while optimizing subwavelength processes.

Services

Design Services. We assist our industry partners and customers with semiconductor designs that use our phase shifting and OPC technologies. Our design services include creating phase shifted designs, applying OPC technology to designs and verifying the final design layout. Our design services help industry partners and customers adopt our technologies.

Technology Integration Services. We offer technology integration services to allow our industry partners to integrate our software products with their products for marketing to their customers. We develop software interfaces to semiconductor design tools and equipment to enable the necessary data communication to integrate the operation of the combined products.

Customers and industry partners

We license our proprietary technologies and software products to companies in key markets within the semiconductor industry. Our customers include licensees of our phase shifting technology and software, manufacturing data preparation software and silicon verification, photomask verification and automated layout creation software. Our industry partners integrate our technologies and software into their products and act as resellers. The following customers and/or industry partners accounted for annual license, maintenance and technical service revenue of at least $250,000 in either 2001, 2000 or 1999:

IDMs and Foundries
Agilent
Cypress Semiconductor
Delco
Hitachi
Hoya
Intel
Infineon
IBM
LSI Logic
Macronix
Matsushita
Motorola
NEC
Phillips
Qualcom
Samsung
Silicon Integrated Systems
SMIC
ST Microelectronics
Texas Instruments
Toshiba
TSMC
UMC
VLSI Technology

Design Tool Vendors
Cadence Design Systems
Synopsys

Semiconductor Equipment Manufacturers
Applied Materials
KLA-Tencor
Leica Micro
Zygo

Photomask Manufacturers
DuPont Photomask
Photronics
Toppan

Cadence and Intel represented 23% and 20%, respectively, of our total revenue for 2001. Cadence represented 24% of our total revenue for 2000. KLA-Tencor, Zygo and Cadence represented 23%, 17% and 16% of our total revenue for 1999, respectively. No other customer accounted for 10% or more of our revenue in 2001, 2000, or 1999.

Research and Development

Our future success will depend to a large extent on our ability to rapidly develop and introduce new proprietary technologies and software products and enhancements to our existing products. We have made and expect to continue to make substantial investments in research and development. We invested $16.2 million (33% of revenue) in 2001 in R&D for product development and engineering programs to improve or sustain existing product lines. The complexity of phase shifting and OPC technologies requires expertise in physical IC design and layout, photomask manufacturing, optical lithography, numerical algorithms and software development. We believe that the multidisciplinary expertise of our team of scientists and engineers will continue to advance the market and technological leadership. Our ability to advance the market and technological leadership is dependant upon our ability to retain our current team of scientists and engineers, as well as recruit new scientists and engineers with the requisite skill set to advance our proprietary technologies and software products. We must compete for some of these individuals in the very competitive Silicon Valley market, where our headquarters are located.

As of December 31, 2001, our engineering group consisted of 116 employees. These employees are focused on the following objectives:

Product Development. Our product development group is organized in teams around the different products we offer. A separate team within this group develops our common core technology and ensures that each product fits into this common architecture.

Advanced Research. Our advanced research group works independently from our product development group to assess and develop new technologies that meet the evolving needs of subwavelength design and manufacturing.

Product Engineering. Our product engineering group is primarily focused on product release, platform support, quality assurance and product documentation.

Sales and Marketing

We rely on our direct sales force and on our industry partner relationships to penetrate each key market of the semiconductor industry. Domestically, our direct sales force operates primarily out of our headquarters in California. We also employ sales personnel in Oregon, Virginia, Minnesota, and Texas. In addition, we have subsidiaries in Canada, Korea, Japan, Taiwan and The Netherlands, which work closely with resellers and partners. We intend to continue to expand our sales and support personnel both domestically and internationally. In order to do so, we must compete for some of our personnel in the very competitive Silicon Valley market where our headquarters are located. As of December 31, 2001, we had 64 employees involved in sales and marketing.

Our marketing personnel focus on developing our relationships with industry partners. Our industry partners include leading semiconductor equipment manufacturers, such as Applied Materials and KLA-Tencor, and design tool companies, such as Cadence. We also entered into joint-marketing relationships with leading photomask manufacturers, such as Dupont Photomask and Photronics. Our direct sales efforts have focused primarily on licensing to foundries and IDMs. To date, we have concentrated our sales and marketing efforts on selling research and development licenses. We have already entered into production licenses with leading semiconductor manufacturers. We expect to extend these efforts to generate production licenses as semiconductor manufacturers move into production of subwavelength ICs. However, in order to further extend our research and development licenses to production licenses, we must expend significant marketing resources, with no guarantee of success.

See Note 9 to the Financial Statements and Management s Discussion and Analysis of Financial Condition and Results of Operations for information regarding the geographic distribution of our revenue for 2001, 2000, and 1999. We are subject to risks associated with economic and political instability in certain foreign countries.

Competition

The semiconductor industry is highly competitive and characterized by rapidly changing design and process technologies. The market for phase shifting and OPC solutions is rapidly evolving and we expect competition to continue to increase. Our software products face direct competition from other providers of software tools for phase shifting, OPC and manufacturing data preparation and automated layout creation solutions, including Avant!, Mentor Graphics and Prolific, Inc. We also compete with companies that have developed or have the ability to develop their own proprietary phase shifting and OPC enabling solutions, such as IBM. Many of these companies are larger than we are, have greater financial or other resources than we do and therefore can withstand adverse market or economic conditions more readily than we can. We may also face competition from alternatives to current photolithography systems. In addition, commercially viable manufacturing processes that provide alternatives to our subwavelength solution may be developed in the future by existing or potential competitors. We believe that the principal competitive factors in our market include technology viability, product availability, performance, reliability, functionality, cost and customer service. We believe we compete favorably with respect to each of these factors. Our phase shifting, OPC, manufacturing data preparation and automated layout creation software products compete with existing and future products in the semiconductor manufacturing market. Recently, a competitor has introduced a mask data preparation software product. We may continue to take various steps, including without limitation reducing prices, in order to remain competitive in the market for data preparation software.

Business Combinations

On January 1, 2000, we acquired Transcription Enterprises Ltd. (Transcription), a company incorporated in California. Under the terms of the acquisition, we issued approximately 3,810,000 shares of Series E Convertible Preferred Stock and $40.0 million in notes payable for all of the outstanding stock of Transcription. The total purchase price was approximately $86.0 million, including acquisition costs of approximately $250,000. The Transcription acquisition was accounted for under the purchase method of accounting.

On October 27, 2000, we acquired Cadabra Design Automation, Inc. (Cadabra), a Nova Scotia limited liability company. Under the terms of the acquisition, we issued approximately 3,200,000 shares of our common stock and options to purchase our common stock for all of the outstanding stock and options of Cadabra, of which approximately 2,641,000 shares are actually exchangeable shares. The exchangeable shares are exchangeable for shares of our common stock, on a one-for-one basis, at the option of the holder thereof. Such shares, if not exchanged earlier, will generally automatically convert to our common stock on October 27, 2005. The total purchase price was approximately $110.6 million, including acquisition costs of approximately $3.0 million. The Cadabra acquisition was accounted for using the purchase method of accounting.

For further details of Transcription and Cadabra business combinations, see Note 2 of Notes to Consolidated Financial Statements.

Intellectual Property

Our future success and competitive position depend upon our continued ability to develop and protect proprietary technologies. We rely significantly on a combination of patents, copyrights, trademarks and trade secrets to protect our proprietary technologies and prevent competitors from using our technologies in their products. In the future, we may seek additional patent protection when we feel it is necessary.

Our existing or future patents may be circumvented, blocked, licensed to others or challenged as to inventorship, ownership, scope, validity or enforceability. Third parties have advised us of literature which they believe to be relevant to our patents. It is possible that this literature or literature we may be advised of in the future could negatively affect the scope or enforceability of either our present or future patents. We may not receive competitive advantages from the rights granted under our patents. In addition, our future patent applications may not be issued with the scope of the claims sought by us, if at all. Furthermore, others may develop technologies that are similar or superior to our proprietary technologies, duplicate our proprietary technologies or design around the patents owned or licensed by us. We are aware of and are evaluating certain patents with which our products, patents or patent applications may conflict. If any of these patents are found to be valid, and we are unable to license such patents on reasonable terms, or if our products, patents or patent applications are found to conflict with these patents, we could be prevented from selling our products, our patents may be declared invalid or our patent applications may not result in issued patents. Additionally, changes in the patent laws, including the interpretation or enforcement of patents, may adversely affect the scope, validity or enforceability of our patents. In addition, in foreign countries, we may not receive effective patent and trademark protection. We cannot be sure that steps we take to protect our proprietary technologies will prevent misappropriation of our technologies.

In addition, we generally enter into confidentiality agreements with our employees, industry partners and customers, as well as generally control access to and distribution of our documentation and other proprietary information. Despite this protection, unauthorized parties may copy aspects of our current or future software products or obtain and use information that we regard as proprietary.

The semiconductor industry is characterized by vigorous protection and pursuit of intellectual property rights or positions. There are also numerous patents in the semiconductor industry and new patents are being issued at a rapid rate. This often results in significant and often protracted and expensive litigation. From time to time third parties may notify us of intellectual property infringement claims. If it is necessary or desirable, we may seek licenses under these third party patents or intellectual property rights. However, we cannot be sure that third parties will offer licenses to us or that we will accept the terms of any offered licenses.

If we fail to obtain a license from a third party for proprietary technologies that we use, we could incur substantial liabilities, or suspend sales of our software products or our use of processes requiring the technologies. Litigation could cause us to incur significant expenses, harm our sales of the challenged technologies or software products and divert the efforts of our technical and management personnel, whether or not a court decides the litigation in our favor. In the event we receive an adverse result in any litigation, we could be required to pay substantial damages, cease sales of infringing products, expend significant resources to develop or acquire non-infringing technology and discontinue the use of processes requiring the infringing technology or obtain licenses to the infringing technology. We may not be successful in the development or acquisition of intellectual property, or the necessary licenses may not be available under reasonable terms, and any development, acquisition or license could require us to expend a substantial amount of time and other resources. Any of these developments would harm our business.

Employees

As of December 31, 2001, we employed 215 employees worldwide, of which 154 individuals were located in the United States and 42 individuals were located in Canada. In the Silicon Valley, where our headquarters is located, competition for highly skilled employees is intense. We believe that our future success is highly dependent upon our continued ability to attract and retain qualified employees. We must also deal internationally with labor and employment laws with which we are not familiar. None of our employees is represented by a labor union or is subject to a collective bargaining agreement. We believe that our relationship with our employees is good.

EXECUTIVE OFFICERS OF THE REGISTRANT

The following table and notes set forth information about our executive officers as of January 31, 2002:

Name	Age	Position
Y. C. (Buno) Pati	37	President and Chief Executive Officer
Yao-Ting Wang	38	Chief Technology Officer
Richard Mora	55	Chief Operating Officer and Chief Financial Officer
Atul Sharan	42	Senior Vice President, Marketing and Business Development
Fabio Angelillis	40	Senior Vice President, Engineering

Dr. Y. C. (Buno) Pati has served as our President and Chief Executive Officer since he co-founded our company in October 1995. From October 1995 to December 1996, Dr. Pati served as an assistant professor of electrical engineering and computer science at Harvard University. From October 1992 to October 1995, Dr. Pati conducted research efforts in computational and system sciences applied to integrated circuit manufacturing at Stanford University. Dr. Pati has published numerous articles in signal processing, communications, fast lithography simulations and automated phase shifting photomask design. Dr. Pati received a B.S., an M.S. and a Ph.D. in electrical engineering from the University of Maryland at College Park.

Dr. Yao-Ting Wang has served as our Chief Technology Officer since he co-founded our company in October 1995. From October 2000 until November 2001, Dr. Wang also served as our Senior Vice President, Engineering. Dr. Wang s doctoral dissertation research was on automated design of phase shifting photomasks using fast algorithms and signal processing techniques. Dr. Wang is active in the areas of fast lithography simulations and automated advanced photomask designs, with specific interests in communications, signal processing and lithographic techniques. Dr. Wang received a B.S. degree from National Taiwan University and a Ph.D. in electrical engineering from Stanford University.

Richard Mora has served as our Chief Operating Officer and Chief Financial Officer since October 2001. Mr. Mora served as our Chief Financial Officer from October 2000 to October 2001. From May 1999 to October 2000, Mr. Mora served as our Chief Financial Officer and Vice President, Operations. From August 1994 to April 1999, Mr. Mora was Chief Financial Officer and Vice President of Finance at Mattson Technologies, Inc., a semiconductor equipment manufacturer. From June 1998 to May 1999, Mr. Mora was also Vice President and General Manager of the High Temp Products Division at Mattson. From September 1988 to August 1994, Mr. Mora served as Chief Financial Officer and Vice President of Finance at Actel Corporation, a semiconductor manufacturer. From June 1985 to August 1988, Mr. Mora was Chief Financial Officer and Vice President of Finance at HHB Systems. Mr. Mora received a B.S. in accounting from Santa Clara University and is a Certified Public Accountant.

Atul Sharan has served as our Senior Vice President, Marketing and Business Development since October 2000. From October 1998 to October 2000, Mr. Sharan served as our Vice President, Marketing and Business Development. From April 1997 to October 1998, Mr. Sharan was director of strategic business development at Ambit Design Systems. From May 1991 to March 1997, Mr. Sharan held senior sales and marketing management positions at Compass Design Automation. From December 1984 to May 1991, Mr. Sharan worked in semiconductor manufacturing operations at VLSI Technology and Integrated Device Technology (IDT). Mr. Sharan received an M.B.A. from the University of California at Berkeley, an M.S. in engineering from the University of Houston, Texas and a B.Tech. degree in engineering from the Indian Institute of Technology in Kanpur, India.

Fabio Angelillis has served as our Senior Vice President of Engineering since November 2001. From September 2000 to November 2001, Mr. Angelillis was Executive Vice President of Engineering at KANA.

From October 1990 to September 2000, Mr. Angelillis held various management positions, including Vice President of Research and Development and Operations at Cadence Design Systems, a provider of electronic design automation software, for their Custom IC product line. From January 1988 to October 1990, Mr. Angelillis served as Engineering Manager at Teradyne, Inc., a manufacturer of automatic test equipment and related software for the electronics and communications industries. Mr. Angelillis holds a B.S. degree in computer engineering from the University of Florida.

Item 2: Properties

Our executive offices and principal operations are currently located in approximately 39,300 square feet of office space in San Jose, California under a lease that expires in July 2004. We also lease approximately 4,500 square feet of office space in Los Gatos, California under a lease that expires in January 2006 and 15,200 square feet of office space in Canada under a lease that expires in February 2002. In addition, we currently sublease approximately 11,000 square feet of office space in San Jose, California to a third party. This lease and sublease expire in December 2004.

We lease office space for sales, customer support and research and development offices in six locations throughout the world: two in North America, three in Asia and one in The Netherlands.

We consider the above facilities suitable to meet our requirements and believe that suitable or substitute space will be available as needed to accommodate expansion of our operations.

Item 3: Legal Proceedings

None

Item 4: Submission of Matters to a Vote of Security Holders in Fourth Quarter ended 2001.

No matters were submitted to a vote of security holders of the registrant during the fourth quarter of the year ended December 31, 2001.

PART II

Item 5. Market For Registrant s Common Equity and Related Stockholder Matters

Our common stock is traded on the Nasdaq National Market System under the symbol of NMTC. The following table sets forth, for the periods indicated, the low and high bid prices per share for our common stock as reported by the Nasdaq National Market.

	Low	High
Year Ended December 31, 2001		
First Quarter	$ 9.000	$ 28.750
Second Quarter	7.875	26.150
Third Quarter	13.100	29.820
Fourth Quarter	13.910	38.650
Year Ended December 31, 2000		
Second Quarter (beginning April 7, 2000)	$ 22.000	$ 56.250
Third Quarter	26.750	67.313
Fourth Quarter	9.125	35.250

As of January 31, 2002, there were approximately 303 holders of record of our common stock. Since many holders shares are listed under their brokerage firms names, the actual number of shareholders is estimated by the Company to be approximately 11,000.

No dividends have been paid on the common stock in 2001, 2000 and 1999. We currently intend to retain all future earnings, if any, for use in our business and do not anticipate paying any cash dividends on our common stock in the foreseeable future.

Recent Sales of Unregistered Securities

There were no sales of unregistered securities during the quarter ended December 31, 2001. However, during the quarter ended December 31, 2001, 572,469 exchangeable shares of Cadabra Design Automation Inc. (Cadabra), which were issued in connection with our October 2000 acquisition of Cadabra, were exchanged for an equal number of shares of our common stock. We did not receive any consideration in connection with such exchanges. These shares were exchanged pursuant to Regulation D or Regulation S of the Securities Act of 1933.

Item 6. Selected Consolidated Financial Data

The following selected consolidated financial data should be read in conjunction with, and are qualified by reference to, the consolidated financial statements and related notes and Management s Discussion and Analysis of Financial Condition and Results of Operations appearing elsewhere in this Form 10-K. The consolidated statements of operations data for the years ended December 31, 2001, 2000 and 1999, and the consolidated balance sheet data at December 31, 2001 and 2000 are derived from our audited consolidated financial statements included in this Form 10-K. The consolidated statements of operations data for the years ended December 31, 1998 and 1997, and the consolidated balance sheet data at December 31, 1999, 1998 and 1997 are derived from our audited consolidated financial statements not included in this Form 10-K. The historical results are not necessarily indicative of future results.

Year Ended December 31,				
2001	2000	1999	1998	1997