Despite a decline in overall industry growth, RP users worldwide produced an estimated 3.55 million models and prototype parts in 2001. This is up 18.3% from the 3 million models produced in 2000. An estimated 2.34 million and 1.86 million parts were produced in 1999 and 1998, respectively.


**About the Report**

This annual market study has established a tradition of offering high-quality analyses that cover all facets of rapid prototyping, including business, product, market, technology, and applications. Forty-nine experts, 47 service providers, 25 system manufacturers, and countless others assisted with its development. The 250-page softbound publication includes 25 charts and graphs, 23 tables, and 87 photographs and illustrations.

"The report has become a virtual 'Bible' of RP ... comprehensive and well organized ... and is highly recommended."

— David Cohn, Engineering Automation Report

"Nothing comes close to the authoritative and comprehensive nature of this annually-updated report. It has something for everybody and I highly recommend it."

— Jeffrey Rowe, MCADCAfe.com
# Table of Contents

Acknowledgments  
About the author  
Focus of this report  
Introduction to rapid prototyping and tooling  

**PART 1: BACKGROUND**  
History of RP systems  
Industries being served  
- How RP models are being used  
- Installations by country  
Applications  
- Communication  
- Engineering changes  
- Good ideas and powerful proposals  
- Concept models  
- Verifying CAD databases  
- Styling, ergonomic studies  
- Functional testing  
- Prototypes  
- Metal castings  
- Early input from suppliers, toolmakers  
- Quote requests  
- Rapid tooling  
- Rapid manufacturing  
- Unlimited potential  

**PART 2: INDUSTRY GROWTH**  
Number of models being produced  
Revenue growth  
- Revenues from products and services  
- 3D Systems dominates  
- Material sales  
- Revenues from service providers  
- Secondary market  
- Revenues from other services  
Unit sales  
- 3D Systems leads  
- Systems sold by region  
- Cumulative systems sold by region  
- Units sold by U.S. manufacturers  
- Units sold by Japanese manufacturers  
- Cumulative unit sales by manufacturer  
- Unit sales by manufacturer and year  
- 3D printer sales by manufacturer and year  
Growth trends and sales forecasts  
- Unit sales growth percentages  
- Worldwide revenue estimates  
- Annual revenue growth percentages  
- Comparing growth of RP and machining markets  
Service providers  
- Growth and location  
- Mix of machines  
- Market segment continues to shrink  
- Number of models produced annually  
- Investment casting  
- Working with service providers  
- Challenging times  
- What is driving prices downward?  
- What lies ahead?  

**PART 3: TOOLING**  
Advances  
- Growing list of methods  
- Thermal management  
- Risk factors  
Indirect approaches  
- Silicone rubber tooling  
- Epoxy-based composite tooling  
- Spray metal tooling  
Real cost of RP  
RSP Tooling  
- Ford’s Sprayform  
- Cast kirkite tooling  
- RPM (rubber plaster mold) casting  
- 3D Keltool  
- PolySteel  
- EcoTool  
- Swiftool  
- PHAST  
- V-Process  
- Others  
Direct approaches  
- Direct AIM tooling  
- SLS tooling  
- DMLS  
- POM  
- Others  
Other considerations  
- Machined tooling  
- Laminate tooling  
- Hybrid tooling  
- Space Puzzle Molding  
- Tool design software  
- Size of tooling market  
Tooling comparison matrix  

**PART 4: SYSTEM MANUFACTURERS**  
3D Systems  
- Materials  
- SLS business  
- OptoForm  
- MJM  
- Other developments  
Arcam  
- Beijing Yinhua  
Cubic Technologies  
- EOS  
- EOSINT P 380  
- 20-micron metal powders  
Envision Technologies  
- F&S GmbH  
- Generis  
- Kinergy  
Objet  
- QuadraTempo  
- Support material  
- Sales underway  
Optomec  
- ProMetal  
- R4 and R10 products  
- Recent developments  
Sanders Design International  
- Schroff Development  
- Solidica  
- Solidscape  
- Stratasys  
- Dimension  
- Other developments  
Z Corp.  
- Z810  
- ZCast  
- Other activities  
Others  
- Helisys  
- Cubital  
- Röders  
- BMT  
- Aaroflex  
- Real cost of RP
RP stocks
Revenues and earnings
Industry consolidation
Trends and areas of interest
Outlook

PART 5: ASIA & EUROPE

Asia
Hong Kong
China
Singapore
Japan
Unit sales
Japanese strategy
CMET, Sony/D-MEC, others
Acceptance of non-SL technologies
Sheet lamination systems
Developments, trends
Lagging software development
Accelerated growth expected

Europe
RAPTIA
United Kingdom
Germany
Italy
France
Sweden
Finland
Denmark
The Netherlands
Belgium

Other regions
Brazil
India
South Africa
Australia
Canada
RP groups and associations

PART 6: RESEARCH & DEVELOPMENT

Developments, patents
3D printers and concept modelers
Denken Engineering
Solidimension
BMT
Speed Part

Metal and ceramic parts
AeroMet
CAM-LEM
SRI International
Others

Small parts
microTEC
MEMGen
Mesoscale Integrated Conformal Electronics (MICE)
Others

Large objects
Generis
Others

MIT’s 3DP technology
3DP process
Major areas of focus
ProMetal
Z Corp.
Soligen
Specific Surface
Therics
Others

U.S. government-sponsored R&D

NSF funding
DoD funding
DoC funding

RP academic programs
RP educational activities
Basic research activities
Applied research activities
Future trends and contributions from academia

PART 7: OTHER DEVELOPMENTS

Growth of solid modeling
Getting good estimates
Seat and revenue estimates
Unsaturated market

RP materials
Stereolithography resins
Resin business in flux
Materials for other RP processes
3D printers

Medical modeling
Medical imaging to RP
Materials for medical RP
Research
RP’s impact

Reverse engineering
The technology
3D digitizing and scanning
Data modeling and surface creation
First article inspection
Note to the wise

PART 8: WHERE IT’S ALL HEADED

Tough times, bright future
Economy
Something is missing
Necessity is the mother of invention
Silver lining

Formula for success
Divergent paths
3D printing
Rapid manufacturing
What to expect
Last great barrier
New rules

Where to learn more
Internet mail list
GARPA
RPA/SME

APPENDICES

Appendix A: Glossary of terms
Appendix B: RP system manufacturers
United States
Israel
Europe
Japan
China
Singapore

Appendix C: Rapid tooling technology developers
United States
Europe

Appendix D: RP software companies
Appendix E: Material suppliers
Appendix F: U.S. RP system specifications
Appendix G: RP systems manufactured outside the U.S.
Appendix H: Material properties
Appendix I: 3D digitizing systems
Appendix J: Reverse engineering software
The Author

Terry Wohlers is the principal author of Wohlers Report 2002. He has authored more than 250 books, articles, reports, and technical papers on engineering and manufacturing automation. Terry has presented to thousands of engineers and managers and has been a keynote speaker at major industry events around the world.

Development Team

The following individuals and organizations contributed to Wohlers Report 2002.

- Shreyas Bakshi - Protosys Technologies Private Ltd. (India)
- Umberto Baraldi - CRIF (Belgium)
- Alain Bernard - University of Nancy I (France)
- Nico Blessing - FHG Institute for Mfg. Eng. & Automation (Germany)
- Mike Braig - A.G. Edwards & Sons
- Tim Caffrey - Caffrey Consulting
- Ian Campbell - Loughborough University (England)
- Andy Christensen - Medical Modeling LLC
- Chua Chee Kai - Nanyang Technological University (Singapore)
- Stuart Clyens - Danish Technological Institute (Denmark)
- Amba Datt Bhatt - Motilal Nehru Regional Engineering College (India)
- Deon de Beer - Technikon Free State (South Africa)
- Jonas de Carvalho - University of São Paulo - São Carlos (Brazil)
- Philip Dickens - Loughborough University (England)
- Dimitri Dimitrov - University of Stellenbosch (South Africa)
- Thierry Dormal - CRIF (Belgium)
- Willie du Preez - CSIR (South Africa)
- Frits Feenstra - TNO Institute of Industrial Technology (The Netherlands)
- Boris Fritz - Northrop Grumman Corp.
- Vito Gervasi - Milwaukee School of Engineering
- Ian Gibson - University of Hong Kong (China)
- Tim Gornet - University of Louisville
- Tom Greaves - New Directions Consulting
- Joe Greco - Greco Consulting
- Ed Grenda - Castle Island Company
- Todd Grimm - Accelerated Technologies, Inc.
- Russ Harris - Loughborough University (England)
- Berndt Holmer - IVF Industrial Research and Development Corp. (Sweden)
- Masato Imamura - Tokyo Research Center (Japan)
- Luca Iuliano - Politecnico di Torino (Italy)
- Tahar Laoui - University of Leuven (Belgium)
- Debbie Leeson - Vantico (South Africa)
- Weiyin Ma - City University of Hong Kong (China)
- Bent Mieritz - Danish Technological Institute (Denmark)
- Bill Mutch - Belcan Corp.
- Mike Naylon - Queensland Manufacturing Institute (Australia)
- Andy Norwood - Loughborough University (England)
- Thanhush - Arizona State University
- Shi Yusheng - Huazhong University of Science and Technology (China)
- Michael Siemer - Walt Disney World Company
- Geoff Smith-Moritz - CAD/CAM Publishing
- Rupert Soar - Loughborough University (England)
- Brent Stucker - University of Rhode Island
- Dave Tait - LFEX Technologies
- Jukka Tuomi - Helsinki University of Technology (Finland)
- David Wimpenny - University of Warwick (England)
- Millan Yeung - National Research Council of Canada (Canada)
- Jenny Yu Hoi Jin - University of Hong Kong (China)
- Millan Yeung - National Research Council of Canada (Canada)
- Shi Yusheng - Huazhong University of Science and Technology (China)

How To Order

Wohlers Report 2002

In the U.S., the report is $395, which includes Priority Mail shipping. To order one or more copies, send your Visa, MasterCard, or American Express number and expiration date, along with your signature, or send a check for the total amount.

For orders outside the U.S., send your Visa, MasterCard, or American Express number, expiration date, and signature. Payment by credit card is required. The price for orders outside the U.S. is $425, which includes Global Priority Mail shipping.

If you are not fully satisfied with the report, you will be issued a refund. Phone orders are accepted.

Order Form

Complete the following form and fax or mail it to Wohlers Associates.

Please print clearly.

Method of Payment

Credit Card (Required for orders outside the U.S.)

- Visa
- MasterCard
- American Express

Card Number ____________________________
Expiration Date _________________________
Signature _______________________________

Number of copies

Name _________________________________
Company ______________________________
Address _____________________________________________________________
City _____________________________________________
State ____________________________________________
Postal Code _____________________________________________
Country _____________________________________________
Phone _____________________________________________
Fax _____________________________________________
E-mail _____________________________________________

Wohlers Associates, Inc.
OakRidge Business Park • 1511 River Oak Drive
Fort Collins, Colorado 80525 USA
970-225-0086 • Fax 970-225-2027
twohlers@compuserve.com • wohlersassociates.com
The scanning strategies were being investigated to potentially achieve a more uniform temporal and spatial distribution of the laser energy, possibly leading to reduced part distortion, by scanning the beam across the sheet surface with both continuous and segmented irradiation geometries. The experimental results revealed that the cross spider scanning strategy could form square and circle sheets into spherical domes.