The Injection Molding and CNC Machining Market for Prototype and Low-Volume Contract Manufacturing

2013

ORCInternational

Contents

Introduction

The goal of this research was to understand and define the market for prototyping and low-volume contract manufacturing using injection molding and CNC machining. This report provides a detailed look at the contract manufacturing market in the United States and provides estimates for the market in the European Union and Japan.

Building a Market Model

Estimating the size of large, complex markets can be difficult, particularly when the markets cover a broad range of industries and applications. ORC International has recently presented a white paper and webinar titled "*Utilizing an Alternative Method to Effectively Estimate Market Size.*"[1] In that paper, we discuss different methods of estimating market sizes by incorporating published data with limited primary research into a market model. To size a market, we first identify different types of 'basis data' - quantitative data that are characteristic of the market of interest - and then obtain relational data to convert the basis data to the desired market size.

- Basis data: Data available from published or other sources that can be related to the size of the market of interest
- Relational data: Data that provide the conversion of the basis data to the target market size.

For a copy of ORC International's whitepaper on market sizing please email answers@orcinternational.com or visit our website at www.orcinternational.com.

In "*Utilizing an Alternative Method to Effectively Estimate Market Size,*" we discussed the process and benefits of developing relational data through industry interviews. Industry experts may come in many forms such as consultants, participants, academics, and knowledgeable observers such as associations. While individuals may not know the actual size of the market, these various Subject Matter Experts (SME) active in the market can still be invaluable assets to the project by assisting in various ways such as,

- Brainstorming potential model components
- Identifying which inputs may have the most significant impact on the final calculation
- Estimating relative sizes of inputs

[1] "Utilizing an Alternative Method to Effectively Estimate Market Size," Ashley James, ORC International, June 2013.

In this paper we discuss the use of expert interviews to estimate a complex market. We then compare the results to a second calculation of the same market but with a more extensive data set generated through a survey of industry participants conducted in partnership with Industrial Designers Society of America (IDSA). Finally the results are extended to provide partial segmentation of the market and to size international regions. The market we chose for this project is the contract manufacture of functional prototypes and low-volume production parts via injection molding and CNC machining, a large, complex, global market that is not well documented. By 'functional' we mean the part must have the intended strength, appearance, and mechanical function of the final production part. This report provides a detailed look at the market in the United States and then extends the results to the European Union and Japan.

Exploring Potential Data Sources

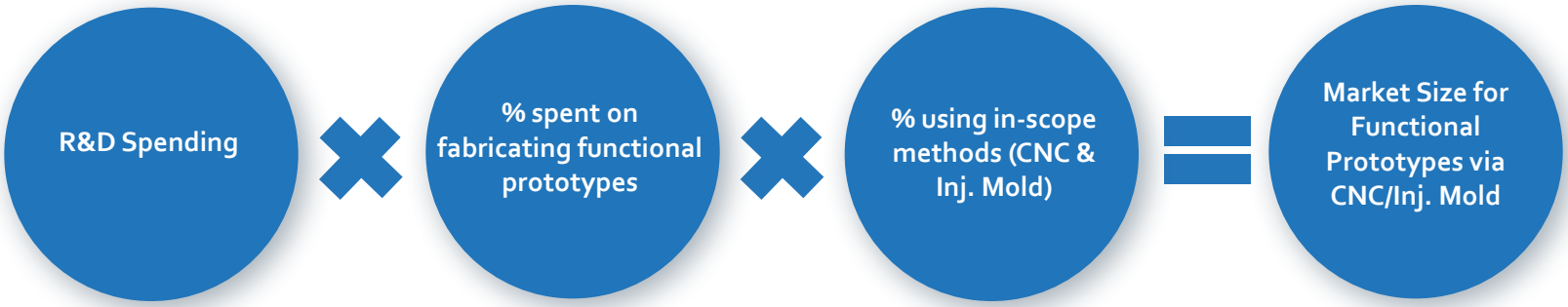
The project was initiated by brainstorming data that could be used to describe the market. Options considered included:

- Amount of research dedicated to prototyping
- Number of companies producing prototypes
- Number of people designing prototypes
- Number of people constructing prototypes

During the brainstorming stage of the project, we engaged experts in product design, CNC machining, and injection molding from ORC's Intota Expert Network (www.intota.com) to gather different perspectives on the sizing problem. Discussion points included how we should think of the prototyping process and of the likelihood of quantifying various inputs. Of the options enumerated, the correlation between demographics such as college degrees and professional activity appeared to be nebulous within the design community. We therefore gave lower priority to methods that use numbers of people designing or constructing prototypes. The project settled on two models to explore; 1) prototyping as a percentage of R&D spend, and 2) cost of prototyping activities per company.

Utilizing Qualitative In-Depth Interviews

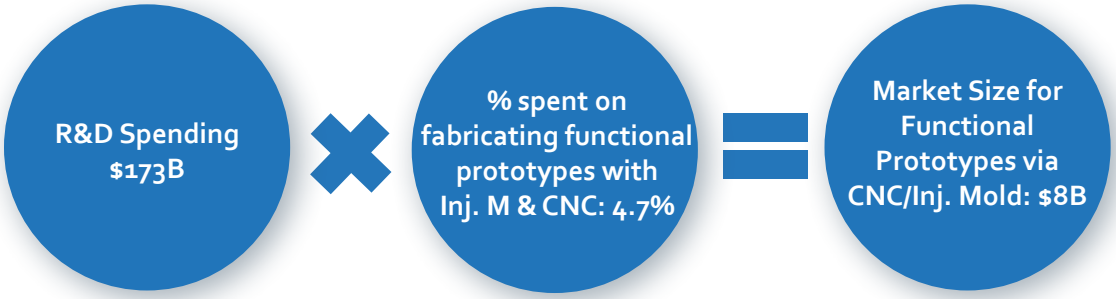
We selected R&D expenditures to explore with a panel of industry experts. R&D expenditures have the advantage of being tracked at a high level for various economies and thus aggregated data are available. The project would need to develop relational data consisting of estimates of the percentage of R&D spend used in producing functional prototypes with in-scope fabrication methods. The high-level design became the following:



We selected R&D data published by the Organization of Economic Cooperation and Development (OECD)[2] for the basis data to have a consistent source of spend for the US, EU and Japan. For relational data we sought input from executives and managers within corporate R&D and prototyping functions. The best number of interviews will be highly dependent on issues such as the complexity of the market, the details desired, and the budget available. For a market as complex as prototyping across the entirety of US industry, estimates from a limited number of interviews are necessarily a compromise between detail and budget. However, by assembling a panel of experts who have a broad perspective of industry coupled with the ability to envision how this complex problem could be partitioned, one is able to collect a rich set of representative information with relatively few interviews. For this project, we engaged 12 R&D managers and executives from various industries to discuss prototyping trends, fabrication methods, and spends.

Industry	Title
Computer/Electronics	Advanced Manufacturing Engineer and Prototyping Lab Manager
Medical	Vice President R&D
Automotive	Director of Innovation & Design
Industrial Design	Former Association President
Lighting	Director R&D, Engineering & Operations
Appliance	Senior Manager R&D
Computer/Electronics	Director of Product Engineering
Medical	Director Product Development
Medical	Senior Director of R&D
Aerospace	Director of Engineering
Consumer	Vice President, Design & Development
Consumer	Design & Prototyping Lab Supervisor

The OECD R&D data are reported by International Standard Industrial Classification (ISIC) codes allowing some segmentation of the results by industry. R&D expenditures were grouped under 14 industries including "other manufacturing" for miscellaneous in-scope codes and "other" for industries unlikely to provide significant contributions to the market. Where possible, SME estimates were matched with specific industries and the median value (2.7%, mode 2%) was used for the remaining industries. The weighted result across all contributing factors was a market estimate of $8B.



[2] http://stats.oecd.org/ as seen April, 2013. Intra-site navigation (menu on left) = Science, Technology and Patents/Research and Development Statistics/ Expenditures/Business enterprise R-D expenditures by industry (ISIC rev. 4). Date of last update: March 2013. Date of data vary by country and are generally 2010.

Utilizing Qualitative Surveys: Spend per Company

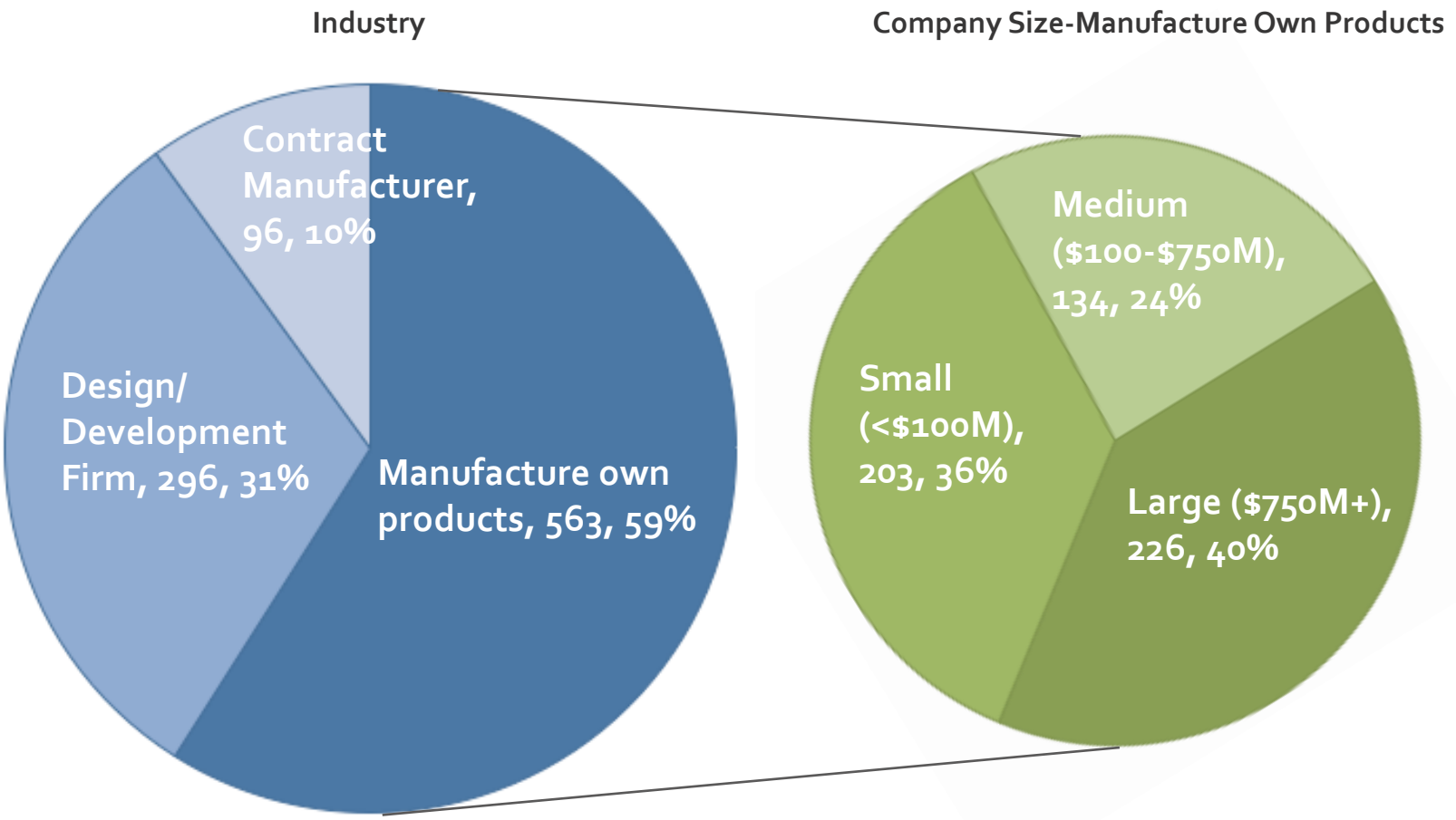
To test the outcome of the expert interviews and to delve deeper into various market sub-segments, we conducted a second study of the same market. For this estimate, the relational data were collected through a survey of designers, engineers, and other individuals involved with prototyping activities. This methodology allows a comparison of the top-down approach of a relatively few expert interviews with a more bottoms-up approach of input from many front-line practitioners. The basis data chosen were the number of companies that may be prototyping products. The relational data would need to include the number of in-scope prototype parts developed per year, the method of fabrication, and the cost of producing the parts. The number of unique prototype parts per segment would be calculated by multiplying the number of products developed per year by the number of in-scope prototyped parts per product. The resulting model was as follows

ORC teamed with Industrial Designers Society of America (IDSA) in June, 2013 to conduct the online survey. Participants were asked

- If they represented contract manufacturers, design firms, or manufacturing companies
- To which of fourteen industries they belonged
- If their company was small (<$100M), medium ($100-$750M), or large ($750M+) in terms of revenue

We took the opportunity to extend the study to look at outsourced vs. in-house fabrication trends and several factors impacting the potential size of the opportunity for contract manufacturers. The project sent out approximately 129,000 email invitations and received 955 full or partial responses. For this example, the 563 responses from members of manufacturing companies were used to build the market estimate. Medians were used in constructing the estimates so as not to let outliers inflate the total prototyping spend in any one segment. Results from contract manufacturers and industrial designers were reviewed as a comparison point and found to align well with the manufacturer responses. To avoid asking for sensitive cost information, average order sizes in US dollars parsed by industry, company size, and fabrication method were provided by a prototype contract manufacturing company.

Demographics of survey respondents



Opportunity roll-up by industry segment

Industry	Small ($0 -100 M)	Medium ($100 – 750 M)	Large ($750+ M)
Aerospace	$XX M	$XX M	$XX M
Appliance	$XX M	$XX M	$XX M
Automotive	$XX M	$XX M	$XX M
Telecommunications	$XX M	$3.1 M	$XX M

Sample Calculation

Component	Calculation	Source and Description For Data
Median Number of Products per Year Per Company	15	IDSA/ORC Survey Data
x	x	
Median Number of Parts per Product	20	IDSA/ORC Survey Data
x	x	
Weighted Cost Per Order	$2,500	Based on sample of contract manufacturing spend segmented by industry and company size, weighted for percent of fabrication being CNC/injection molding.
x	x	
Number of Companies per Segment	34	Compiled from D&B data based on select NAICS codes and excluding 75% of companies with revenues < $1M/year
x	x	
Addressable Percent	12.30%	IDSA/ORC Survey Data Outsourced parts only, in-scope sizes, no secondary operations or first part inspection
=	=	
Addressable Market	$3.1M	

The project team reviewed NAICS codes[3] and made a judgment regarding which codes to include within the count of companies in the basis data. According to Dun & Bradstreet,[4] the resulting collection of in-scope companies is dominated by companies in the 'small' category, accounting for 98.4% of the dataset. A significant number of the smallest companies were assumed to provide minimal contributions to the overall market. Based on evaluations of the client base of a contract manufacturing firm, it was decided to reduce the number of companies with revenues below $1M per year contributing to the model by 75%. The final company count was 151,000, and the average spend per company after weighting for all contributing factors was $41,300. Multiplying the basis and relational data gives an estimated market size of $6.2B for functional prototyping using injection molding and CNC machining.

[3] http://www.naics.com/
[4] http://www.dnb.com/

Whether the delta between these two results - $8B for the interviews and $6.2B for the survey - is a large or small difference will be a matter of one's need. Some companies may require very precise information to make specific strategic plans, and the investment into a survey-based process will be required. However, in many cases companies are seeking an initial understanding of the market and the size of a particular opportunity. The juxtaposition of the two methods demonstrates the power of harnessing the knowledge of a limited number of experts for the development of initial market models.

Seeking Additional Opportunity; Adjacent Market Segments

When examining markets, companies are frequently interested in the various market segments that would represent opportunities for growth. There are multiple ways to think about adjacent growth, such as new customers, new services to existing customers, and new geographic regions. Questions one can ask include

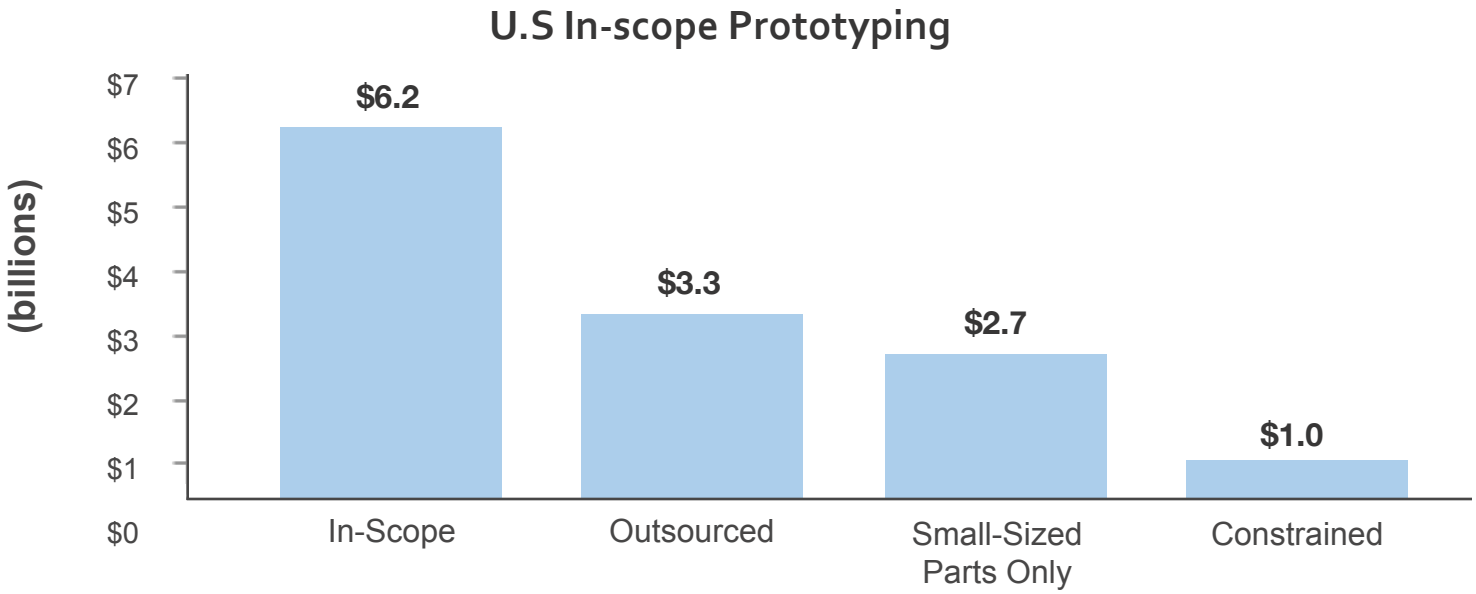
- What portion of the market is accessible to my services?
- What portion of the market is accessible if I expand my services?
- What growth might I achieve through geographic expansion?

We utilized the industry survey to examine further segmentation of the U.S. market by including questions on trends affecting purchasing decisions of prototyping services. Participants were asked

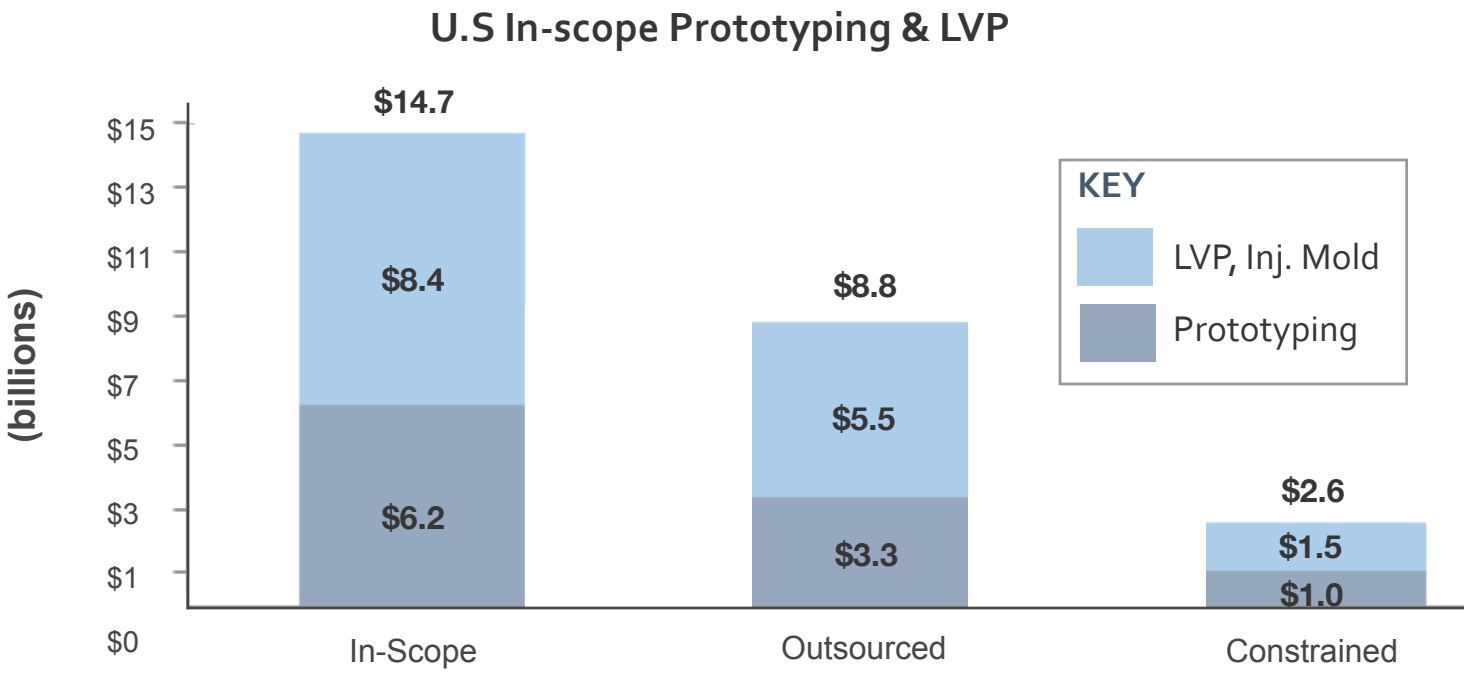
- Percentage of various fabrication methods that are outsourced
- Percent of parts small enough to be fabricated with common operations (below 20"x 30"x 5")
- Percent of jobs that require services beyond fabrication that might be required to win a contract, explicitly first-part inspection and providing or managing secondary processes (e.g., surface finishing)

Based on the survey results, a little over half (54%) of the in-scope prototyping activity is outsourced, resulting in a $3.3B market in the U.S. This market, however, is only available to the full-service providers. Once the constraints on part size and additional services are added the size of the opportunity drops from $3.3B to $1.0B. From the perspective of a contract manufacturer within the 'fully constrained' market – someone who is focused on just providing the prototype parts – there are a couple of adjacent services one could consider to increase the size of the market served.

Increasing part sizes is not the largest opportunity as 'common-sized' parts are about 80% of the outsourced market ($2.7B). The opportunity is in providing additional services such as first part inspection and managing secondary processes, which accounts for about $1.6B or about half of the original $3.3B outsourced market (the delta from $2.6B down to $1.0B).

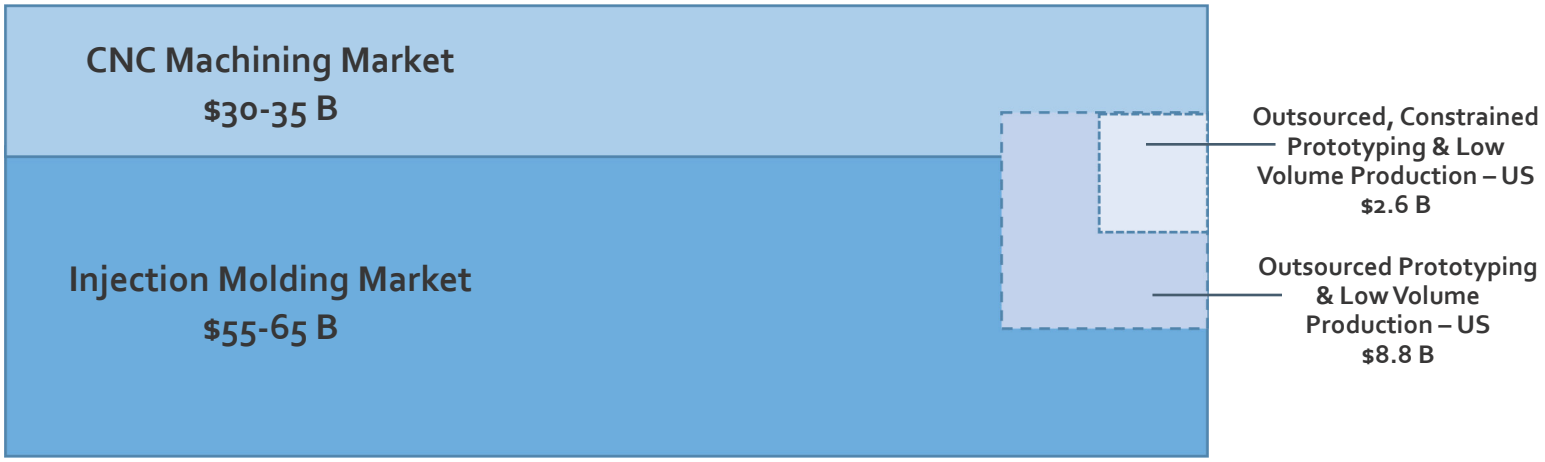


Another potential opportunity is to expand into low-volume production runs. Once the mold is available for prototyping, it may also be available to produce a limited number of production pieces. Additional survey questions asked participants about their needs for injection molded parts below 20"x 30"x 5" in size and below 40,000 in number per year. Similar to the approach taken with prototyping, participants were asked about outsourcing trends and service requirements but we obtained average cost data outside of the survey. According to survey participants, low-volume production (LVP) more than doubles the market under consideration, resulting in an estimated $14.7B in-scope U.S. market that is $2.6B when outsourced and fully constrained.



As a comparison, IBIS estimates the North American market of CNC machining to be $30-$35B[5] and PCRS estimates the market for injection molding to be $55-65B.[6] This would make our $8.8B outsourced market approximately 8-10% of the combined $85-110B CNC and injection molding market.

Relative Sizes of Various Injection Molding and CNC Markets



Extrapolating Estimates to International Regions

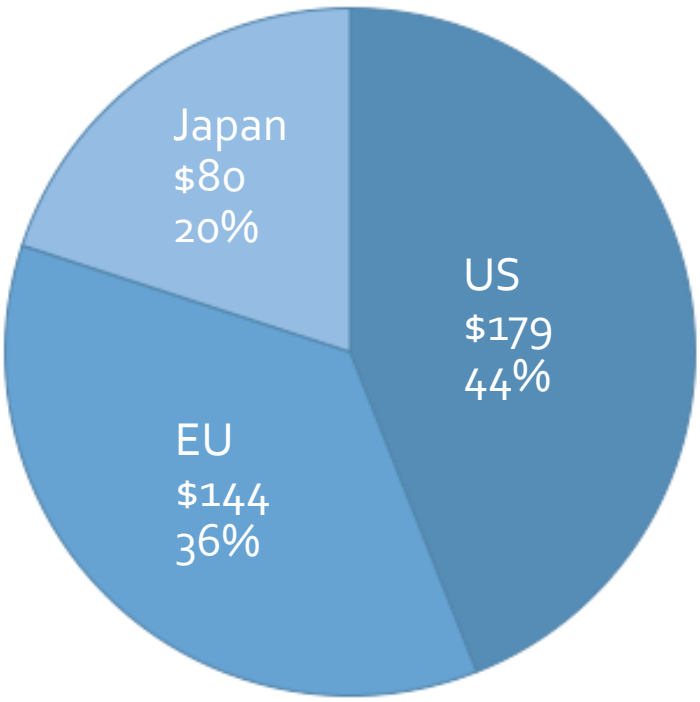
In addition to examining possible mixtures of services to expand a potential market opportunity, one can examine moves into adjacent geographic regions. For this project, we were interested in the potential opportunity of expanding services to Japan and the European Union. Each of the three markets – the U.S., EU, and Japan – is unique with its own individual characteristics, but all three economies are highly developed with similar quality requirements serving many of the same industries. It is reasonable, therefore, to assume that at a high level the three economies have similar prototyping activities and that an estimate of the size of these international markets can be obtained through an application of the U.S. results. For this project, OCED R&D spend was used as the basis data. The same ISIC categories included in the U.S. study were included for the other regions. The relational data are taken from the project results as simple ratios of market spend to R&D spend. The following calculation was made per segment in each region, and totaled as shown below.

[5] "World machine Shop Services in the US," IBIS July 2011
[6] "Plastics Industry Report," PCRS May 2011

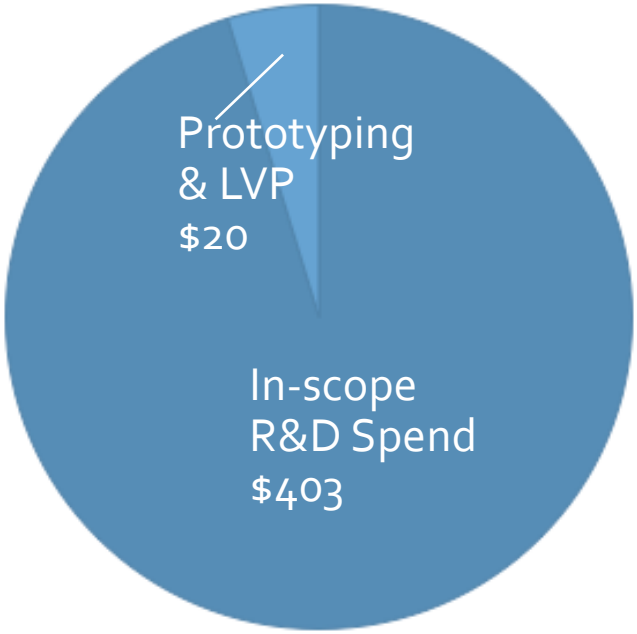
		Prototyping		LVP Inj. Mold		Prototyping & LVP Combined	
Region	In-Scope R&D Spend	In-scope, Outsourced	Fully Constrained	In-scope, Outsourced	Fully Constrained	In-scope, Outsourced	Fully Constrained
U.S.	$179B	$3.35B	$1.0B	$5.48B	$1.53B	$8.8B	$2.6B
Japan	$80B	$1.50B	$0.47B	$2.45B	$0.69B	$3.9B	$1.2B
EU	$144B	$2.69B	$0.84B	$4.41B	$1.24B	$7.1B	$2.1B
Total	$403B	$7.5B	$2.4B	$12.3B	$3.5B	$20B	$6B

Based on this approach, the total market for outsourced prototyping and low-volume production of parts manufactured by either injection molding or CNC machining processes is approximately $20B across the United States, European Union and Japan. This corresponds to approximately 5% of the total R&D spend of in-scope companies across all industries. However, when the examined constraints are applied, this market shrinks considerably. For example, if we look at only those parts that are made in the most common size ranges and which do not require secondary operations, etc., we find the total constrained market to be approximately $6B for the three regions combined.

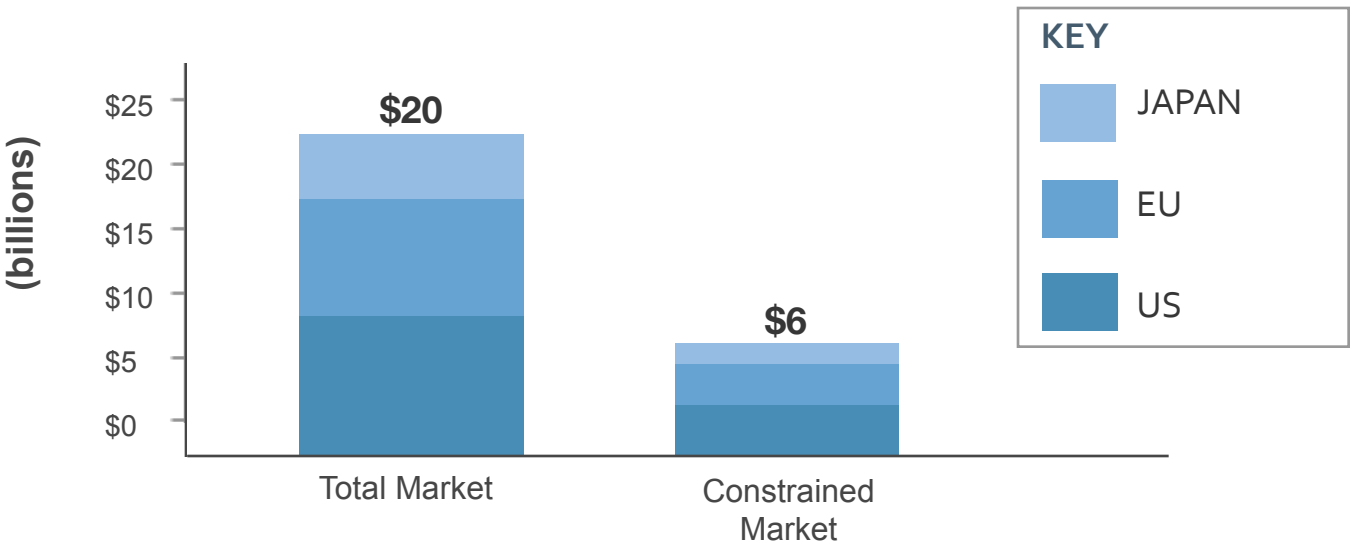
In-scope R&D Spend: US, EU, Japan
Source: OECD
Total: $403B



Outsourced Injection Molding &CNC Machining in US, EU, and Japan Relative to Size of In-scope R&D spend



Outsourced Injection Molding & CNC Machining in US, EU and Japan Prototyping & Low Volume Production



Recap

We demonstrated the sizing of a complex market – fabrication of functional prototypes and low volume production of parts using injection molding and CNC machining – through the construction of two different market models. In both cases the model started with published 'basis' data – statistics that in some manner describe the market of interest – and we then applied 'relational' data to convert the basis data into the final market estimates. The relatively close agreement between the two methods ($8B from 12 expert interviews vs. $6.2B from 563 survey responses) demonstrates how an initial market estimate can be achieved through a relatively few interviews with knowledgeable industry experts.

We then demonstrated how the survey approach could be used as one tool for further segmentation of the market in the quest to understand the respective trends and requirements. We found about 53% of the U.S. in-scope prototyping market is being outsourced ($3.4B of $6.2B). While a contract manufacturer can capture a sizable portion of that market working with 'common' part sizes ($2.7B of $3.3B outsourced market, about 82%, defined as parts smaller than 20" x 30" x 5"), only about 31% of the market ($1.0B of $3.3B outsourced market) is available to those who do not provide additional services such as first-part inspection and managing secondary processes such as surface finishing.

Finally, we examined potential opportunities for adjacent moves into various other market spaces. Injection molding requires machining appropriate tools. Once they are prepared and parts prototyped, adding low-volume production runs can more than double the available market, as the available outsource market in the U.S. grows from $3.3B to an estimated $8.8B ($1.0B to $2.6B for fully constrained, outsourced market). Alternatively, one could consider geographic expansion. Based on an application of the U.S. survey results to other regions, opening the entirety of the Japanese and European markets result in an approximately $20B outsourced market ($6B fully constrained).

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IDSA is the world's oldest, largest, member-driven society for industrial design. IDSA represents professionals in product design, ergonomics, design management, and related design fields. The organization has 30 professional chapters in the US and internationally.

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- Tailor sales and marketing messages more accurately
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Vice President, ORC International

Brian joined ORC International in 2004 and along with Ashley James leads business intelligence research and analysis for clients in ORC International's technology and industrial practice. Brian's custom research projects have covered many facets of the services at ORC International including market assessment, technology assessment, intellectual property analysis, supply chain assessment, best practices analysis, benchmarking, and competitive assessment & analysis. Brian's market studies have addressed issues in various markets such as chemicals, resins, consumer and medical products, packaging, construction and construction products, safety, and other industrial sectors. Projects have examined trends, dynamics, competitive products, and unmet needs in new and existing markets and applications. Prior to ORC International, Brian spent 12 years at The Dow Chemical Company in a variety of functions within R&D and Environmental Operations. Brian obtained his B.S. in Chemistry from the University of Detroit and a Ph.D. in Physical Organic Chemistry from The University of California, Berkeley.

Acknowledgements

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