

Price-Setting Strategies for Product Innovations in the Medtech Industry

**Authors: Benjamin Cohen*
and Michael Neubert**

*Corresponding author



Abstract: This article analyzes the research problem of price-setting strategies for product innovations in the medtech industry. It is based on the conceptual framework of price-setting practices, strategies, and models. A multiple case study research is then performed on six medical technology companies, focusing on how they set their initial product price for a new technology solution to either existing medical conditions or technology limitations. The research results show that medtech companies opt for competition-informed price practices and buy pricing models. The pricing strategies vary between skimming and market-based pricing strategies. Price innovations are limited due to regulation and financial considerations.

Keywords: Price-setting, pricing practice, pricing strategy, pricing model, medtech

Introduction

Price-setting for any new product is crucial in determining its future in the market. After years of research and development (R&D), product design, testing, market research, and marketing, the first real interaction a product has with the customer is through its price. It is not the idea of how its utility will benefit the customer nor the vision and excitement given about how things will change. Those are unrealized expectations preserved until after the customer has ownership. The price is the real, hard currency promise of what this product will mean to the customer.

There is a great need for all companies to understand and optimize their pricing strategy. Price-setting determines a company's profit margin as well as market share – the ease in making sales or the difficulty in gaining adoption. It is perceived as a profit opportunity invitation to future competition and a territorial grab to existing competitors. Marn and Rosiello (1992) studied the economic parameters of 2,463 companies and found that a 1% improvement in price yielded an 11.1% improvement in operating profit, all else being equal. This compared dramatically high as compared to a 1% improvement in either the variable costs, sales volume, or fixed costs, which yielded operating profit gains of 7.8%, 3.3%, and 2.3%, respectively.

With the possibility of any product or industry to focus on, this paper has chosen the medical technology (medtech) industry. This focus has been chosen because of the amount of money spent on R&D investment, the rapid advancements made in recent years, the growing worldwide demand in advanced medtech products, and the absence of existing research. Further, medtech products often consist of physical products, consumables, and services, the combination of which increases the pricing complexity.

Medtech companies are providing cutting-edge technologies to patients, hospitals, and care providers around the world. It would appear that as the world becomes more interconnected toward a single common marketplace, the faster the rate of technological development becomes. With an increasing rate of technological development at the same time as larger customer exposure, greater necessity is placed on a medtech company entering new markets with the correct marketing and pricing strategies.

The purpose of this study is to identify various international pricing strategies and models used in real world companies. From this selection, comparison can be made of their relative strengths and proper implementation. The problem in this research is that international pricing decisions are more complex than domestic, frequently incurring currency value swings, differing inflationary pressures, and difficulty in having production facilities in different markets, which leads to frequent price reviews (Hollensen, 2014).

This study has been performed in part by the call for research from Ingenbleek, Frambach, and Verhallen (2013). In their paper, they call for further research on existing pricing processes with the intent of applying them toward optimal application for new product development. Thereto, it is suggested to address this need through qualitative research methods such as multiple case study research.

Literature Review and Theoretical Framework

Successful price-setting strategies and models can be derived from a large number of literature sources centered on either the conceptual derivation or empirical results. However, sources of failure risk are often more easily learned from case studies found in literature research. In short, the success and failure risk factors relevant to bringing a new product to market can be generalized as originating from either the product, company, competition, customer, international market complexity, or new sub-industry oriented focus. Evidence for each of these focuses is found in a selection of recently published literature.

Product-Oriented

Product expectation from customers of a new product's performance should be adequately met by appropriate price-setting strategies. Proper pricing leads to a balance between the product's usefulness and the expectations placed on it from consumers. Ingenbleek et al. (2013) find that inappropriate selection of price-setting practices can counter the positive advantages of new product development. By pricing a product high, customers will have high initial expectations for quality, durability, application, and ease of use among others which the product must fulfill. Customer opinion may begin to undervalue the benefit it brings by comparing it with the standards applied to other products at similar prices. Undervaluing a product decreases the consumer confidence in performance and durability, as well as pride of ownership. The consumer is only content when the balance between cost and benefit is met. This selection of a pricing strategy is therefore dependent on the relative level of product advantage, intensity of competition, and relative product costs. This multiple case study research uses the theoretical framework of Ingenbleek et al. (2013) to analyze the pricing strategies of medtech companies.

Specifically, for a new product entering an existing market or creating a new market, value-informed pricing strategy provides the greatest support for a product's pricing strategy. After this, competition-informed pricing adds substantially in situations where competitive intensity is low, whereas cost-informed pricing helps when competitive intensity is high. Likewise, managers pursuing a profit margin objective should express the advantage of their product, thus using value-informed pricing while avoiding cost-informed pricing. In total, Marn, Roegner, and Zawada (2003) estimate 80-90% of new products brought to market are priced too low, and consequently reach a smaller market size and level of profitability than is possible. This has significant negative effects on the company's revenue stream by decreasing short-term profit as well as long-term customer confidence and loyalty (Lowe & Alpert, 2010).

Lowe and Alpert (2010) identified a clear causal effect for the pioneer's price-setting decisions on product price and value perceptions, whereas a follower company's product price seemed to influence perceptions of the follower, not the pioneer. These findings imply that reference price is brand specific, and that the pioneer, due to its prototypicality, has a stronger influence on reference price perceptions than the follower. However, these effects were stronger for the more innovative product categories being examined.

Online distribution channels greatly increase price transparency, which leads to reduced price differentials between countries and a global standardization of prices (Gorodnichenko & Talavera, 2016). Prices in online markets have been found to change faster than in traditional stores, including a higher pass-through of exchange rate fluctuations.

These changes depend on the products and on market conditions such as level of competition.

Specifically, for medical devices, the clinical trial procedure is found to be the best way to estimate a product's cost effectiveness for future customers (Kirisits & Redekop, 2013). These trials are able to reach a broad and diverse range of potential customers with varying levels of severity of the condition being targeted by the new product. From these trials, the performance of the device and degree of benefit can be identified and weighed against its ease of use and any potential harms. The degree of rigor and completeness to these clinical trials is the best way to forecast its acceptance by the public.

Company-Oriented

When a firm develops a high-technology product filling a small market niche, its full potential needs to be quickly exploited in order to generate sufficient revenue needed to cover its R&D costs, to finance growth, and to offer competitive prices (Neubert, 2015; Trudgen & Freeman, 2014). Therefore, significant product growth is necessary, as well as creating and completing the product's distribution path to the public. Proper relationships with the company's supply chain as well as distributors, import/exporters, and retailers is critical as the performance of one company will depend on the performance of the entire chain (Wei & Zhao, 2014).

Luostarinen and Gabriellson (2006) studied 89 companies in Finland which became international within their first three years, and thusly named born global companies (Neubert, 2015). They found that these companies often bypassed cost-informed pricing (setting a product's price floor) by choosing below-cost pricing for their first international customer and thereafter applying value-added pricing based on the benefits brought to its customers. This method was found to be hugely beneficial to the company creating the product in terms of creating the first international partnership, acquiring initial market share, and finding a more optimal partnership that conveyed confidence in customers not already familiar with the manufacturing company. This brings compounded returns in the form of additional business being brought-in more easily.

Even before focusing on the product and customers, the best qualities of successful lean start-up companies have been identified as controlling overhead costs and automating as many of the company procedures as possible (Grohn et al., 2015). These actions are often indicative of proper cost-control efforts set by the management, and a focus on the bottom line. Examples of such efforts include the purchase of used equipment or negotiation with vendors and suppliers after a more thorough market research of asking prices.

Competition-Oriented

Knowledge of the pricing strategies, product development, and marketing practices of a company's competitors leads to greater positioning of a company within the overall market. Success of any product originates from one or more advantages that it has over other available product options. Kuznetsova and Roud (2014) performed an industry survey among Russian manufacturing firms to rate their relative company advantages as compared to their competitors. From the results, they found that the highest perceived advantage of the survey respondents' companies was product quality over their competitors, with 76% of respondents believing their own company produced products at higher quality as compared to 17% of respondents believing in their competitor's product quality advantage. The next largest discrepancy in perspectives was of fast, on-time delivery, in that 43% believed their company had the advantage as compared to 9% giving advantage to their competitors. Roughly 6% of respondents believed that their company possessed no competitive advantages at all, whereas 30% believed that the competitors possessed no advantages. The survey results showed roughly even numbers

between the respondents' companies and their competitors in the categories of price, cutting-edge products, adaptation to consumer needs, and service.

Placement of one product helps the product and company succeed in the short-term. However, long-term planning and investment in product improvements and further technological advancement are vital in assuring continual benefit from the product line. Copeland and Shapiro (2015) found that continual and significant innovation increases the competitive advantage of a product, thus leading to higher prices for the innovator. The constant reworking and renewal of a product's strengths, capacities, and features creates a moving barrier to entry for competitors. Likewise, slower rates of innovation make the retail market more competitive, leading to decreasing company markups and profits.

Customer-Oriented

No greater entity exists for the protection of customers' best interests than the multitude of government sponsored healthcare programs around the world. Assuring patient safety as well as cost control from healthcare providers are the top two priorities. Specifically relating to overall cost, Gobbi and Hsuan (2015) determined that nearly 65% of the public sector in the US medical industry used collaborative purchasing (CP) power in 1995 to reduce the price of complex medical equipment purchases. They found that purchase of said equipment equates to the largest portion of total expenditure in the realm of healthcare. Because the healthcare providers (predominantly hospitals) have strikingly similar requirements of the machines, equipment, and devices purchased, the potential for CP to decrease overall costs is high. Proper purpose and functionality for the customer must be addressed in order to gain customer adoption of a new technology, as more often than not the needs of customers create the product opportunities for companies. Specifically, for medtech companies, aging demographics and increasing availability to modern medicine for most of the world have created significant growth opportunities. For example, the leading healthcare demands within the United States include decreasing costs, patient safety, personalized care, and advanced cancer research (Deloitte, 2016). Compare that with the Gulf Cooperation Council (GCC) states where healthcare concerns stem from the region's increasing population such as lifestyle diseases (including ischemic heart disease, stroke, type 2 diabetes, and obesity), high incidence of road traffic accidents, and consanguinity (Howard, 2014).

Other countries have made medical tourism a primary focus for the growth of their economy. Such countries as Thailand, Singapore, India, Jordan, Turkey, and the United Arab Emirates have each incurred rapid growth in their healthcare infrastructure in order to satisfy their growing domestic markets as well as attract the international patients (Ebrahim & Ganguli, 2017). These countries aim to benefit from increased demand for the healthcare products and services beyond the level of domestic demand. This effectively causes the hospitals, retailers, and healthcare providers to increase their customer base without the need for export/import concerns and costs.

Foreign Market Complexity Oriented

International expansion of a company is a significant milestone in its global growth and capture of market share. Yet for many companies this step proves to be a substantial inhibitor to smooth progress. The benefits of an increase in potential customer base are offset by increased costs burdened by consumers, additional governmental regulation and safety controls, cultural or language difficulties, and increased competition. This market adaptation includes a revision of pricing decisions (Neubert, 2016b).

Therefore, entry into a foreign market is only possible after extensive analysis of the market factors and competition (Neubert, 2013). Pricing

decisions require regular reviews and structured decision-making processes in order to prepare for and mitigate disturbances caused by changes in foreign competition, currency exchange fluctuation, and inflationary pressures (Snieskiene & Cibinskiene, 2015). Thereto, exporting companies have been found to experience greater rate of success depending on the relationship and partnerships formed with importers (Obadia & Stöttinger, 2015). Exporters can increase the performance of their importers through their pricing strategies, especially by allowing higher margins or other incentive schemes. In response, importers then invest in the products where they can expect the best results, predominantly based on the marketability and the price margin.

Creation of a new product market or niche comes with the significant advantage in that high-tech firms have a high price-setting power to set the reference price for their new product categories. New niche creation has historically come with roughly one to two years of market control before competitor companies can technologically catch up (Lowe & Alpert, 2010). This advantage is substantially decreased in foreign markets that don't enforce patent protection. Geng and Saggi (2015) analyzed pricing strategies of patented (e.g. pharmaceutical) products sold into markets without patent protection and found that local competition was quickly generated. Such presence led to price competition for market share, meaning lower markups and profitability.



There is a great need for all companies to understand and optimize their pricing strategy. Price-setting determines a company's profit margin as well as market share.



New Sub-Industry Oriented

New products don't always have to conform to existing standards and processes. A relatively recent trend in market growth is in the remanufacturing of medtech products from used or recycled old products. Companies around the world, but particularly in Europe, are being held responsible for the collection of end-of-life products. With the added responsibility of either recycling or safely and environmentally disposing of what remains of the medtech products, many companies have found ways of reintegrating the recycled materials into new products (Bulmus, Zhu, & Teunter, 2014). Certain low-tech items such as single-use cameras and refillable containers have been found to be best suited for a remanufacturing process and can be repeatedly refurbished, refilled, and resold to the customer at nearly the same initial price. To the contrary, high-tech products such as mobile phones and personal computers (PCs) were identified as being of greater reliability and durability concern for customers and thus cannot fetch sales prices anywhere near the new product price. These products would then need to be sold to completely different secondary markets where the perceived quality of remanufactured goods is higher or at highly reduced prices.

Companies who incorporate remanufacturing into their existing manufacturing business have been found to capture higher market share than companies who do not (Mitra, 2015). This comes from the socially conscientious perception and positive imaging that a decrease in mining and generation materials is an ecologically sensitive and

morally positive practice. It is suggested that both the market share capture and the environmentally friendly marketing should serve as sufficient motivation for early life-cycle companies, especially in higher eco-friendly or sustainability focused industries or customer bases.

Unfortunately, the remanufacturing process isn't without its complications and sales challenges. The most positive effects of the remanufacturing process are in energy saving and pollution reduction, whereas the negative effects are most likely concerns from consumers regarding product quality and service of remanufactured products (Zhu et al., 2015). Early analysis suggests that modifications to the product offering could offset these consumer concerns with optionality including extending the product's warranty length or offering free product replacement should anything fail or operate improperly.

Research Method

A multiple case study research method shall be used in order to best compare and contrast existing pricing strategies used by medtech companies. This study uses a multiple case study research question to answer the explanatory (why and how) research questions (Yin, 2014). According to Hennart (2013), a qualitative comparative case study research would help to answer the research question. In contrast to an experimental design or a survey, a multiple case study has more flexibility (Stake, 1995), allows an in-depth analysis of a complex research problem within a highly contextualized environment (Rosenberg & Yates, 2007), and a comparison between different cases (Baxter & Jack, 2008; Eisenhardt & Graebner, 2007).

The medical industry in general is a very difficult but interesting industry to identify pricing strategies, particularly within the United States and other countries with large governmental healthcare payer systems. In other countries within the Organization for Economic Cooperation and Development (OECD), the majority of prices for medical services, equipment, and prescription drugs are fixed or set in reference to these government-established reference prices (Brandt, 2013). In the US, it is commonly known as the Centers for Medicare & Medicaid Services (CMS) billing rates. Therefore, the new medtech companies are principally targeting technology innovations not currently outlined in these governmental payer systems.

Sampling

The choice of the sampling strategy is based on the purpose of this study. This study uses a purposive case selection strategy (Seawright & Gerring, 2008) because it produces a representative sample with typical (Gerring, 2006) and successful examples of the total population. According to Yin (2014), this sampling strategy produces a statistically representative sample if at least six to ten cases are selected. This study uses a sample size of six case study firms to allow a better triangulation of data and to strengthen the results of the whole study.

The six case study firms, EnteroMedics, Alphatec Spine, Inogen, Skyline Medical, GE Healthcare, and Intuitive Surgical, are born-global firms using the global exporter business model (Neubert, 2016a). These companies are all publicly traded companies (5 on NASDAQ, GE on NYSE) with market capitalization ranging in size from \$8 million to \$260 billion. Five of the six companies specialize uniquely within the medical equipment and supplies industry, while GE is a multinational conglomerate with exposure in a broad range of industries. This sample was determined sufficient for the study due to the breadth of pricing strategies and models identified between them.

Research Questions

The statement of the research problem has led to the following two research questions:

1. What pricing strategies and models are currently being

implemented in the medtech industry?

2. Where are the observed differences and benefits between the pricing strategies and models?

Research Findings

Through researching dozens of companies, it was found that a company cannot state outright its pricing strategy. This is firstly because the terms and definitions of pricing strategies and models are in no way standardized and, secondly, because in doing so a company may substantially weaken its market position and brand quality, inviting in new competitors. Therefore, inferences must be made as to why and how a company chose its pricing models. In order to make such inferences, enough detailed information must be revealed about a company's product line revenues and costs, thus leading the research to focus on publicly listed companies on US stock exchanges. For the sake of reducing repetition, the comparison between companies described below can be found in Table A1, along with description of the pricing strategy and model keywords found in Table A2.

A substantially large number of medical device suppliers were found which focused their product offerings within the most standardized and wide-spread sub-sectors of medical equipment. Specifically, in the areas of EKG/ECG, MRI, ultrasound, and x-ray machines, the level of competition is so significant that the price a new entry company could receive for its product, regardless of any superiority in quality, reliability, or features, would likely be a significant barrier to entry. Substantial market competition puts substantial R&D expenditures at risk for ever being recovered. The technology behind this equipment and the expertise of installation and utilization have been disseminated around the world quickly, and therefore, for the sake of this research, are not included as being cutting-edge technologies. They have been, however, included in the comparison table for completeness of review.

Findings RQ 1: What pricing strategies and models are currently being implemented in the medtech industry?

The companies of EnteroMedics, Alphatec Spine, and Inogen were researched, each belonging to a different specialty sector within the healthcare field. EnteroMedics manufactures its Maestro device that uses its neuroblocking technology known as vBloc Therapy to treat obesity, metabolic diseases, and other gastrointestinal disorders (EnteroMedics, 2016). Alphatec Spine manufactures a variety of products for the surgical treatment of spine disorders (Alphatec Spine, 2017). Inogen specializes in the design, manufacturing, and marketing of portable oxygen concentrators for patients necessitating oxygen therapy (Inogen, 2017).

The first finding is that each case study company bases their product pricing in the US on the CMS billing rates. By doing so, the prices are thus established by the US Medicaid reimbursement rates, meaning a competition-informed price-setting practice. Therefore, the price-setting strategy of all companies is that of market pricing. Each company additionally operates primarily under the buy only pricing model, with Inogen mentioning the service segment of their business generating significant revenue.

Skyline Medical is a company specializing in the collection and disposal of infectious fluids that result from surgical procedures and post-operative care (Skyline Medical, 2017). Their principle focus is the Streamway System, with features such as automated measurement of volumes, prevention of cross-contamination, and a tissue trap that allows for tissue retrieval. Disclosed in their 2015 annual report, Skyline implies that their pricing strategy is one of penetration pricing, specifically singling-out their competitor Stryker Instrument's comparable system and citing notable differences (Skyline Medical, 2016). The significant differences mentioned are a 33% savings in device purchase price, an industry common installation process

that can be performed by distributors, independent contractors, or customer in-house engineering, as well as underpricing the disposable kit needed for each patient operation by \$1. Therefore, the pricing practice detailed in the report is that of competition-informed, although undoubtedly an underlying degree of cost-informed practice evaluated to set their product price floor. The company's pricing model is dominantly through the sale of the Streamway units, with the sale of non-reusable filters and cleaning solutions making up a smaller revenue component.

General Electric (GE) is a global conglomerate company with divisions in the aviation, power generation, electricity distribution, healthcare, oil and gas, transportation, household appliances, and financial industries (GE, 2016). In researching cutting-edge medtech technologies, the recent 3.0-tesla (3T) magnetic resonance imaging (MRI) machines developed at GE were identified as being cutting-edge technology in terms of their magnet strength, bore size, and quieter running status. However, pricing information was discovered only through distributors and then only from contact with sales associates. Consequently, a previous model, the 1.5-tesla (1.5T) LX MRI, was found with sufficient pricing information.

Not only had the 1.5T machines been sold initially at higher prices only to be lowered in time with increased competition from other companies and technologies, but sales were initially only available through GE authorized dealers, later opening up to affiliates and then third party vendors. From uncovering the historical change in pricing as well as sales practices, it is evident that GE uses value-informed price-setting practices to establish skimming price-setting strategies for its MRI products. GE does offer both the sale and lease of its MRI units, although not all vendors offer a leasing option. Undoubtedly, GE must have developed its pricing strategy through years of experience in the healthcare as well as other industries in order to maximize returns to the company.

The sixth and final case study included in this report is from Intuitive Surgical (Intuitive). They manufacture the da Vinci Surgical System used in robotic surgeries, along with related instruments and accessories (Intuitive, 2016). Being a young and ambitious publicly-listed medtech company, Intuitive has disclosed the largest amount of pricing information found for this research. In their annual report, Intuitive defines its business strategy priorities all in relation to value to its customers: patient, surgeon, and hospital. With the customer in mind, Intuitive has focused its product technology and further improvements on maximizing the value of the system for its customers, primarily through conversion of standard open surgeries to be compatible with the da Vinci system, to better train surgeons for a larger range of complex minimally invasive surgeries (MIS), and to develop procedures that could convert multiport laparoscopic surgeries into single port surgeries. In all, it is clear that Intuitive employs a value-informed price-setting practice.

Intuitive lists the revenue streams in 2015 from the sale of its surgical systems, sales-type and operating lease options, annual service plan, as well as the non-reusable or gradually degrading instruments and accessories. An impressive 492 robotic systems were sold in 2015, yielding 30% of its annual profits, with another 63 systems delivered to customers under lease terms, yielding less than 1% of profits. On top of that were a combined total of 3,597 systems in use and covered under annual service contracts, bringing in 19% of 2015 profits. Most substantially was the sale of non-reusable or replacement instrument and accessories equaling over 50% of the annual profits. From this information it is clear that Intuitive primarily employs a buy and use pricing model, with a much smaller percentage of clients choosing the leasing option of a recurring pricing model.

Also in the annual report are the ranges of prices charged to its customers for the da Vinci Surgery System, the annual service

agreements, and the non-reusable or gradually degrading instruments and accessories. The range values are not necessarily important, but the magnitude of the discounts given to some customers is substantial. Sale of the da Vinci Surgery System ranges from \$0.6 to \$2.5 million each, meaning some customers may receive up to a 76% discount. The annual service agreements range in price from \$80 to \$170 thousand per year (up to 53% discount), and the instruments and accessories, on a per-use basis, equate to a \$700 to \$3,200 per surgery cost (up to 78% discount). Calculating the average cost for these three categories from the total number of sales, operational units, and procedures in 2015 shows indication that the average price paid is roughly halfway between the maximum and zero discount range. They describe their customer base as being primarily US-based (71% of revenue) as well as being larger governmental hospital chains that purchase the system in bulk, which explains why significant discounts are being offered.

Intuitive also describes its competition in the industry as being the traditional MIS, open surgery, interventional or pharmaceutical options. They describe the robotic option for surgery as an advanced technology, albeit with higher costs, that results in increased and quicker success rates. In all, due to the high cost of the system and limited necessity for the limited specialized surgeries currently with guidelines written for execution using the system, Intuitive is implementing a skimming price-setting strategy with substantial price negotiation (discounting) with the customers.

Findings RQ 2: Where are the observed differences and benefits between the pricing strategies and models?

As seen in the six case study companies, the price-setting practices of competition-informed and value-informed are the dominant ones implemented. Where they differ is when the new technologies are applied to more patient-centered medical conditions (as is the case for EnteroMedics, Alphatec, Inogen, and Skyline) or towards the hospital-centered medical devices (GE and Intuitive).

The first three medtech products are addressing new higher technology solutions to existing patient conditions and therefore have pricing restricted by the US Medicare CMS reimbursement price listing, or more generally a market pricing strategy. Bottom line profit for these companies is therefore most strongly determined by total cost reduction to the customers plus decreasing their own operating costs and expenses. Skyline's product is not patient-specific, and, because of the company's ambition towards significant market share, they have chosen to underprice the product, following a penetration pricing strategy. Bottom line profit for them will come from effective marketing, product performance, and market share growth. Both GE and Intuitive's products are providing higher technology solutions to hospital equipment limitations or competition amongst hospitals for patients needing specialized procedures and tests, thus necessitating skimming price-setting strategies. Bottom line profit for them will come in terms of relative advances their equipment technology has over competitors plus value appeal to the surgeons and patients.

Within this case study selection, the first five companies primarily utilize the buy only pricing model as a result of them all manufacturing machinery or equipment that generate the majority of their revenue, with little to no additional instruments or accessories needed. The sixth company utilizes the buy and use pricing model, thereby having significant revenue coming from both its surgery system and the non-reusable components.

The selection of a pricing model is not a function of company preference but a matter of product delivery and operation by the customer. Perhaps advances in technology can modify the operation or utility of the product, but such solutions often lead to new sub-industries which then carry new areas for growth, opportunity, and pricing strategies and models.

A new sub-industry has been growing in recent years that provides third party sales, servicing, and parts for medical equipment. As a result, many third party service and repair companies have been created which effectively deteriorate the value of original equipment manufacturers' (OEM) pricing models that include maintenance, servicing, and even installation.

This sub-industry grew out of what Scot Mackeil, a biomedical engineer at the Massachusetts General Hospital, describes as large manufacturing companies refusing to allow their customers to self-repair the machines beginning in the 1980s (Bassett, 2014). Mackeil says manufacturers began password protecting the software on the machines, refusing to sell parts, and removing servicing procedures from the so-called service manuals. This created a dependency relationship where the purchaser of the machine had to pay any price that the manufacturer was charging for maintenance.

Companies such as Medical Equipment Repair Associates (MERA), Advanced Ultrasound Electronics, Horizon Biomedical Equipment Services, Tenacore, Curagita, Medical Equipment Solutions and Applications (MESA) among many others have all been created to bridge the gap between technical, machine-specific knowledge and high customer service. These third parties are rapidly growing their market share and eating away at the number of service, repair, and insurance contracts signed with OEMs through offering vendor-neutral advice and operational cost savings. Also worth considering are the multitude of OEMs like Steris who have been acquiring third-party service and repair companies in order to capture market share of the growing new sub-industry.

The Association for the Advancement of Medical Instrumentation (AAMI) has been strongly supporting the legislative front towards the requirement of OEMs to disclose their equipment service manuals and to adopt policies similar to the automotive industry wherein independent service and supply companies have created their own sub-industry.

Conclusions

Through this six-company case study, several advantages and disadvantages to the price-setting practices, strategies, and models were found. In short, the price-setting practice will be determined based on the customer being either single-use patients or large customer throughput hospitals, with the focus being on finding the greatest value for the targeted customers. The price-setting strategy is largely related to the price-setting practice with modifications based on the relative newness of the technology, level of competition, and trade-off between growth in market share or higher profit margins. The pricing model is primarily dependent on the product delivery method and/or operation by the customer, but with modifications possible based on product customization, relationship with the customer, and specialized financing options.

Advantages in competition-informed price-setting practices plus market price-setting strategy include assurance of a fair price along with associated market share, but the disadvantages include significant competition and lower profit margins in order to grow market share. Advantages in value-informed practices as well as the skimming price-setting strategy include higher profit margins leading to quicker profitability while not growing your customer base faster than supply lines and infrastructure needs, but with the disadvantage of lower market share with higher R&D and marketing costs. Advantages of cost-informed practices and the penetration price-setting strategy include setting a price floor and gaining market share, whereas the disadvantages include lower profitability and potentially setting a low reference price from which your customers will continue to demand low prices.

Advantages to the buy pricing model include the largest customer payments at the earliest time to product delivery, which decreases the OEM's financing requirements. The disadvantages to the buy pricing model are that it is more financially intensive for customers, and if the technology advances quick enough will leave customers feeling left behind or disappointed. The lease pricing model is a favorable step for the customer, allowing additional payment options and thus an increased customer base. Disadvantages for the OEM include delayed revenue streams and increased staff to track the various accounts. Pay-per-use pricing models are not applicable for all healthcare device companies, but when they are they bring additional revenue for the OEMs as well as a fairer pricing model between customers who use the product more or less than others. Disadvantages include continual inventory monitoring for both OEMs and customers.

No particular ranking of the price-setting practices, strategies, and models can be made generically. A specific product and target customer are to first be identified, working next to the price-setting. However, it is noted that in general the larger and more successful companies have product lines with price-setting practices and strategies that evolve with the product and industry age, and that contain diverse pricing models to draw in the largest possible customer base.

Future study must include a larger amount of case study companies within the medtech industry, expansion into other new technology industry segments, and could also incorporate the change in price through a particular product's life cycle.



References

- Alphatec Spine. (2017). Alphatec Spine: Improving lives by delivering advancements in spinal fusion technology. Alphatec Spine, Inc. Retrieved January 22, 2017, from <http://alphatecspine.com>.
- Bassett, M. (2014, May 19). The fight for the right to repair: To ensure adequate access to the equipment they are charged to maintain, Biomedics across the nation are looking for ways to take action. *24x7 Magazine*. Retrieved January 27, 2017, from <http://www.24x7mag.com/2014/05/fight-right-repair>.
- Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, 13(4), 544-559.
- Brandt, L. (2013). Price tagging the priceless: International reference pricing for medicines in theory and practice. European Centre for International Political Economy (ECIPE), Policy Briefs #4/2013.
- Bulmuş, S. C., Zhu, S. X., & Teunter, R. H. (2014). Optimal core acquisition and pricing strategies for hybrid manufacturing and remanufacturing systems. *International Journal of Production Research*, 52(22), 6627-6641. doi: 10.1080/00207543.2014.906073.
- Copeland, A., & Shapiro, A. H. (2015). Price setting and rapid technology adoption: The case of the PC industry. *Review of Economics and Statistics*, 98(3), 601-616.
- Deloitte. (2016). 2016 Global health care outlook: Battling costs while improving care. Deloitte Touche Tohmatsu Limited. Retrieved February 06, 2017, from <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-2016-health-care-outlook.pdf>.
- Ebrahim, A. H., & Ganguli, S. (2017). Strategic priorities for exploiting Bahrain's medical tourism potential. *Journal of Place Management and Development*, 10(1). doi: 10.1108/JPM-03-2016-0011.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25-32.
- EnteroMedics. (2016). EnteroMedics: About Us. EnteroMedics Inc. Retrieved January 22, 2017, from <http://www.enteromedics.com>.
- Gabrielsson, P., Gabrielsson, M., & Gabrielsson, H. (2008). International advertising campaigns in fast-moving consumer goods companies originating from a SMOPEC country. *International Business Review*, 17(6), 714-728. doi:10.1016/j.ibusrev.2008.09.008.

General Electric (2016, February 26). Digital industrial: GE 2015 annual report. General Electric Company. Retrieved January 11, 2017, from http://www.ge.com/ar2015/assets/pdf/GE_AR15.pdf.

Geng, D., & Saggi, K. (2015). External reference pricing policies, price controls, and international patent protection. Vanderbilt University.

Gerring, J. (2006). *Case study research: Principles and practices*. New York, NY: Cambridge University Press.

Gobbi, C., & Hsuan, J. (2015). Collaborative purchasing of complex technologies in healthcare: Implications for alignment strategies. *International Journal of Operations & Production Management*, 35(3). doi: 10.1108/IJOPM-08-2013-0362.

Gorodnichenko, Y., & Talavera, O. (2016). Price setting in online markets: Basic facts, international comparisons, and cross-border integration. National Bureau of Economic Research (NBER), Working paper #20406. doi: 10.3386/w20406.

Grohn, K., Moody, K., Wortel, D., LeClair, N., Traina, A., Zluhan, E., & Feuer, G. (2015). Lean start-up: A case study in the establishment of affordable laboratory infrastructure and emerging biotechnology business models. *Journal of Commercial Biotechnology*, 21(2), 60-68. doi: 10.5912/jcb698.

Hennart, J. F. (2013). The accidental internationalists: A theory of born globals. *Entrepreneurship Theory and Practice*, 38(1), 117-135.

Hollensen, S. (2014). *Global Marketing* (6th ed.). Harlow, England: Financial Times Prentice Hall.

Howard, J. (2014, November 20). Medical devices and the Middle East: Market, regulation, and reimbursement in Gulf Cooperation Council states. *Medical Devices: Evidence and Research*, 7, 385-395. doi: 10.2147/MDER.S73079.

Ingenbleek, P. T. M., Frambach, R. T., & Verhallen, T. M. M. (2013). Best practices for new product pricing: Impact on market performance and price level under different conditions. *Journal of Product Innovation Management*, 30(3), 560-573. doi:10.1111/jpim.12008.

Inogen. (2017). Inogen: Oxygen. Anytime. Anywhere. Inogen Inc. Retrieved January 22, 2017, from <http://www.inogen.com>.

Intuitive Surgical. (2016). 2015 annual report. Intuitive Surgical, Inc. Retrieved January 11, 2017, from <http://phx.corporate-ir.net/phoenix.zhtml?c=122359&p=irolHRHome>.

Kirisits, A., & Redekop, W. K. (2013). The economic evaluation of medical devices: Challenges ahead. *Applied Health Economics and Health Policy*, 11, 15-26. doi: 10.1007/s40258-012-0006-9.

Kuznetsova, T., & Roud, V. (2014). Competition, innovation, and strategy: Empirical evidence from Russian enterprises. *Problems of Economic Transition*, 57(2), 3-36. doi: 10.2753/PET1061-1991570201.

Lowe, B., & Alpert, F. (2010). Pricing strategy and the formation and evolution of reference price perceptions in new product categories. *Psychology & Marketing*, 27(9), 846-73.

Luostarinen, R., & Gabriellson, M. (2006, November). Globalization and marketing strategies of born globals in SMOPECs. *Thunderbird International Business Review*, 48(6), 773-801. doi: 10.1002/tie.20122.

Marn, M. V., Roegner, E. V., & Zawada, C. C. (2003, August). Pricing new products. *McKinsey Quarterly*, 40-49.

Marn, M. V., & Rosiello, R. L. (1992, September-October). Managing price, gaining profit. *Harvard Business Review*.

Mitra, S. (2015). Optimal pricing and core acquisition strategy for a hybrid manufacturing/ remanufacturing system. *International Journal of Production Research*. doi: 10.1080/00207543.2015.1067376.

Neubert, M. (2013). *Global market strategies: How to turn your company into a successful international enterprise*. Frankfurt am Main: Campus-Verlag.

Neubert, M. (2015). Early internationalisation of high-tech firms: Past accomplishments and future directions. *International Journal of Teaching and Case Studies*, 6(4), 353-369.

Neubert, M. (2016a). Significance of the speed of internationalisation for born global firms – A multiple case study approach. *International Journal of Teaching and Case Studies*, 7(1), 66-81.

Neubert, M. (2016b). How and why born global firms differ in their speed of internationalization – A multiple case study approach. *International Journal of Teaching and Case Studies*, 7(2), 118-134.

Nobel Media AB. (2014). Nobel laureates and country of birth. Nobel Media AB. Retrieved January 27, 2017, from http://www.nobelprize.org/nobel_prizes/lists/countries.html.

Obadia, C., & Stöttinger, B. (2015). Pricing to manage export channel relationships. *International Business Review*, 24(2), 311-318.

OECD. (2015). Health at a glance 2015: OECD indicators. Paris: OECD Publishing. doi: 10.1787/health_glance-2015-en.

R&D Magazine. (2016, March 11). 2016 global R&D funding forecast. Retrieved January 27, 2017, from https://www.iriweb.org/sites/default/files/2016GlobalR%26DFundingForecast_2.pdf.

Rosenberg, J., & Yates, P. (2007). Schematic representation of case study research designs. *Journal of Advanced Nursing*, 60(4), 447-452.

Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research a menu of qualitative and quantitative options. *Political Research Quarterly*, 61(2), 294-308.

Skyline Medical. (2016). Form 10-K (annual report). Skyline Medical, Inc. Retrieved January 11, 2017, from <http://files.shareholder.com/downloads/AMDA-1XMKYQ/3775285216x0xS1171843-16-8621/1446159/filing.pdf>.

Skyline Medical. (2017). Streamway: The new standard in waste fluid management. Skyline Medical, Inc. Retrieved January 11, 2017, from <http://www.skylinemedical.com>.

Snieskiene, G., & Cibinskiene, A. (2015). Export price: How to make it more competitive. *Procedia-Social and Behavioral Sciences*, 213, 92-98.

Stake, R. E. (1995). *The Art of Case Research*. Thousand Oaks, CA: Sage Publications.

Trudgen, R., & Freeman, S. (2014). Measuring the performance of gone-global firms throughout their development process: The roles of initial market selection and internationalisation speed. *Management International Review*, 54(4), 551-579.

Wei, J., & Zhao, J. (2014). Pricing and remanufacturing decisions in two competing supply chains. *International Journal of Production Research*, 53(1), 258-278. doi:10.1080/00207543.2014.951088.

Zhu, Q., Li, H., Zhao, S., & Lun, V. (2015). Redesign of service modes for remanufactured products and its financial benefits. *International Journal of Production Economics*. doi: 10.1016/j.ijpe.2015.08.015.



Appendix A

Comparison between medtech companies

The pricing strategies and models used by the medtech companies researched in this report are consolidated in the following tables. The data and information found within were personally collected from a variety of company official websites, annual reports, and investor

relations documents, as well as third party websites. Because there are no industry standard definitions of the pricing strategies and models, the definitions used for the sake of this report are also included.

Company	Product Line(s)	Discription	Price-Setting Practices (Specifically)	Price-Setting Strategy (Additional Strategies)	Pricing Model	
					Primary	Secondary
Intuitive Surgical	da Vinci Surgery	robotic surgery	Value-informed	Skimming (Price negotiation)	Buy & Use	Recurring
GE Healthcare	1.5-tesla LX MRI	MRI scan	Value-informed	Skimming (Upgrades / Trade-ins)	Buy	Lease
Skyline Medical Inc	Streamway FMS	fluid disposal	Competition-informed	Penetration pricing (Price negotiation)	Buy	Pay-per-use
EnteroMedics	Maestro (vBloc Therapy)	neuroblocking v obesity	Competition-informed (US Medicare CMS)	Market Pricing	Buy	-
Alphatec Spine	-multiple-	spine surgery	Competition-informed (US Medicare CMS)	Market Pricing	Buy	-
Inogen	Inogen One	portable oxygen	Competition-informed (US Medicare CMS)	Market Pricing	Buy	Service

Table A2: Definition of price-setting practices, strategies, and pricing models used (Hollensen, 2014; Ingenbleek, Frambach, & Verhallen, 2013).

Price Setting Practice	Price Based on...
Value-informed pricing	Customers' perceptions of the benefits that the product offers and that they trade off against the price
Competition-informed pricing	Competitors' prices relative to their market positions
Cost-informed pricing	Variable, fixed, direct, and indirect costs for developing, producing, and marketing the new product or service
Price Setting Practice	Price Based on...
Skimming	The market segment with the highest reference price is targeted first, and the market is subsequently skimmed to capture segments with lower reference prices
Market pricing	Price influences market share
Penetration pricing	Set a low price in attempt to stimulate product adoption
Non-Price Setting Practice	Price Based on...
Selecting price models	Not all purchasing options available for customers
Price negotiation w/ customer	List price minus customer-specific discounts
Bundling	Discounted price when multiple products or services purchased
Upgrades / Trade-ins	Discounted price when an older model/version is exchanged
Captive finance companies	Purchasing price dependant on financing terms
Pricing Model	Revenue Based On...
Buy	One-time payment
Lease / Rent	Recurring monthly/ yeary payments
Lease back	Real estate: sale of asset, lease/rent back from buyer (takes the form of a loan)
Pay-per-use	Pay for each use, do not pay for on-site location or maintenance
Combination buy & use	Sale of product, plus recurring payments for service and non-reusable components
Recurring	Recurring payments comprised of lease/rent, service, and non-reusable components
Reimbursement	Government payer reimbursement of costs, smaller immediate patient copay
Auction	Highest bidder
Dynamic/ Time-based	Price changes as a function of time and supply/availability
Remanufactured	Used goods refurbished or remanufactured and sold as new or lower quality
Second hand	Used goods resold on secondary market
Remarketed	Unsold goods being sold for a different purpose