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Strategic Audit of National Instruments

An Undergraduate Honors Thesis
Submitted in Partial fulfillment of
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Abstract

The research and analyses compiled in this paper provide a holistic view into the current situation that National Instruments faces as a company and what strategies it can take to overcome current and pressing issues. The goal of the audit is to determine a strategic recommendation for National Instruments that will achieve any number of goals and objectives set by the auditor in accordance to the situation at hand. In addition to this strategic recommendation, an implementation and contingency plan are developed to further expand upon how such a strategy would be created in the real world. The strategic recommendation and corresponding plans have been crafted through extensive background research of National Instruments in combination with various tools such as a SWOT Analysis and Porter's Five Forces to analyze the current state of National Instruments. Through analysis and extensive thought regarding possible alternatives, this paper concluded that investing in 5G Test & Measurement development was of highest importance to overcome the low net income issues that National Instruments currently faces.

Key Words: Computer-Engineering, National-Instruments, Strategic-Audit, 5G

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Background and Issues

Data acquisition is the process of gathering and sampling electrical or physical phenomenon (e.g. current, temperature, pressure, etc.) using sensors and converting the data into digital representations that computers can interpret. Data acquisition systems (abbreviated DAS or DAQ) often consist of three separate parts: a sensor, a DAQ device, and a general-purpose computer (National Instruments, n.d.h). However, this was not always the case. Until 1974, companies produced computers that specialized in data acquisition, most notably IBM with its IBM 7700 Data Acquisition System in 1963 and its successor IBM 1800 Data Acquisition and Control System in 1964. Though these computers specialized in data acquisition, they were bulky, expensive, and incapable of providing general-purpose capabilities with the acquired data. By 1974, Tecmar/Scientific Solutions Inc. surpassed these systems with its general-purpose S-100 computers combined with data acquisition cards (Bhatia, Puri, and Behl, 2015).

History of National Instruments

National Instruments began as a desire to bridge the gap between data collection instruments and computer interfaces. During the 1970s, Dr. James Truchard, Jeff Kodosky, and Bill Nowlin met as employees for the University of Texas at Austin Applied Research Laboratories (ARL), conducting research and using primitive computing technology to collect and analyze data. However, the men found these systems inefficient and frustrating to use and set out to develop a more capable solution. Together, the trio purchased a PDP-11 microcomputer to begin designing and developing a General Purpose Interface Bus (GPIB) interface, which would allow engineers to directly port data to a computer for analysis. This was the first of numerous products that National Instruments would create to simplify the jobs of engineers and scientists (National Instruments, 2007a).

Following the success of its GPIB interface products, National Instruments began to pursue a concept that would define its upcoming market progression: virtual instrumentation. In 1986, National Instruments introduced a new graphical programming platform called Lab Virtual Instrument Engineering Workbench (LabVIEW) for the Apple Macintosh. LabVIEW provides engineers and scientists with the capability to program graphically using wires and icons as opposed to traditional text-based programming languages. With this new undertaking, National Instruments took strides to produce “a product that epitomized the company’s desire to initiate, launch, and manage products that carry the potential to change the world”. Shortly after the launch of LabVIEW for the Macintosh, National Instruments developed LabVIEW for Windows-based PCs and UNIX workstations to expand its availability (National Instruments, 2007b).

As LabVIEW gained acclaim from the scientific community, National Instruments subsequently developed its first plug-in DAQ boards for the Macintosh and PC during the late 1980s. These DAQ boards varied in functionality and capability, with some incorporating high performance Peripheral Component Interconnect (PCI) and PCI eXtensions for Instrumentation (PXI) interfaces. Additionally, National Instruments tightly integrated their DAQ boards with their LabVIEW software, providing customers with a low cost measurement system solution. By pursuing the development of these technologies concurrently, National Instruments provided engineers and scientists with the means to “replace expensive, fixed-function, vendor-defined instruments [with] customer-defined, PC-based systems to acquire, analyze, and present data at a lower cost that provided greater flexibility and productivity” (National Instruments, 2007b).

Throughout the 1990s and early 2000s, National Instruments continued to work with its customers to determine how they applied National Instruments' technology in order to expand product offerings as customer needs evolved and grew. For example, National Instruments released machine vision software and hardware between 1996 and 1998, which converts cameras into sensors for measurement and automation applications based on customer needs. This paired well with the company's acquisition of the URL "ni.com", which developed into an all-encompassing source to highlight National Instruments' product and service offerings for customers. Further, the online National Instruments Business Center provided customers with the capability to "configure measurement systems, order and register products, and inquire about order and service requests online". Together, this attention to customer needs and desires has enabled National Instruments to deliver exceptional customer experiences and relevant products into present day (National Instruments, 2007c).

Company Profile

Since its founding in 1976, National Instruments has transformed from a little-known startup in Dr. Truchard's garage into a global industry leader with over \$1 billion in revenue. It has accomplished this feat by adhering to its mission "to equip engineers and scientists with tools that accelerate productivity, innovation, and discovery" (National Instruments, n.d.c). This coincides with the belief that "through its long-term vision of graphical system design and deep commitment to Shared Value, NI fosters the success of its customers, employees, suppliers, and shareholders while making a positive impact on society" (National Instruments, n.d.d).

Within its vision, National Instruments maintains its commitment to the long-term success of key stakeholders and society by focusing on four separate areas of NI Shared Value: "empowering engineers and scientists, inspiring and preparing the innovators of tomorrow, fostering an open and innovative work environment for all employees, and minimizing the company's environmental impact". It is evident throughout its vision, mission, and values that National Instruments aspires to leverage its capabilities to address issues and empower engineers and scientists with tools to drive innovation and solve problems (National Instruments, n.d.d). In doing so, National Instruments has developed a platform on which it has the capability to expand into new markets at will and be at the forefront of innovation in a multitude of industries.

All of these pieces feed into National Instruments' long-term view known as the 100-Year Plan. The plan balances the National Instruments vision and culture with short-term business needs to produce a foundation that will lead to success for many years to come. The company believes that abiding by this plan has produced the success and growth that National Instruments has experienced since its founding and will continue to do so long term. Figure 1 below outlines the 100-Year plan.

The Future: Building a Clock



Figure 1. National Instruments' 100-Year Plan. Adapted from "Annual Investor Conference" by National Instruments, 2009, Retrieved from <http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MjI2NDIzMnxDaGlsZEIEPTM0NjU5OXxUeXBIPtI=&t=1>

Products

As it continues to equip engineers and scientists with tools to accelerate productivity, National Instruments continues to develop new platforms and tools to offer to its customers. Consequently, its product catalog has expanded tremendously from the original GPIB interface into hundreds of different modules, chassis, and software platforms. It is thus necessary to divide all of National Instruments' products into separate platform divisions.

Software

Dating back to the initial release of LabVIEW in 1986, software has been an integral part of the National Instruments platform. All of the software that National Instruments offers is unified and highly interoperable, consisting of "development environments and application software – from configuration-based to programming languages – an extensive set of drivers for interfacing with I/O, and add-ons for specialized deployment platforms". Development environments, such as LabVIEW and LabWindows/CVI, provide customers with integrated development environments to streamline the development, debugging, and deployment of custom engineering systems. Application software, such as TestStand and FlexLogger, simplify challenging engineering problems that customers face, such as discovering and configuring USB DAQ devices, by delivering a point-and-click interface to simplify the process. Software add-ons, such as the Sound and Vibration Toolkit, extend the capabilities of the development environments and application software by providing customers with industry-specific libraries and deployment platforms (National Instruments, n.d.f).

CompactRIO Platform

The CompactRIO (cRIO) platform provides customers with a real-time embedded control system, aimed at implementation in industrial control systems. The system itself features controllers in the form of a chassis with a real-time processor for communication and signal processing and a Field-Programmable

Gate Array (FPGA) that allows users to maintain high-speed control and implement custom timing and triggering directly to the hardware. Additionally, the cRIO system allows for Reconfigurable IO modules (RIO) and Ethernet expansion. Together, this combination of technology “eliminate[s] the need for separate subsystems by connecting directly to sensors, displays, cameras, and motors and take[s] advantage of powerful development and run-time software” (National Instruments, n.d.b).

CompactDAQ Platform

The CompactDAQ platform provides customers with a portable, rugged system that integrates connectivity and signal conditioning for data IO modules, allowing users to easily collect, process, and analyze sensor or signal data in combination with compatible software such as LabVIEW. Similar to the cRIO platform, the CompactDAQ platform features controllers in the form of a chassis containing a timing controller that synchronizes data acquisition from several C Series IO modules and a connected computer. CompactDAQ chassis come in the form of USB, Ethernet, and wireless, each providing different capabilities (National Instruments, n.d.a).

PXI

The PXI platform provides customers with rugged, high performing systems designed for measurement and automation systems. In addition to standard PCI electrical-bus features, PXI integrates the modular, Eurocard packaging of CompactPCI in addition to specialized synchronization buses and expanded software features. While more expensive than other National Instruments products, PXI provides customers with a high performance and low-cost deployment platform in spaces such as manufacturing and industrial test compared to similar specialized systems that can cost magnitudes more (National Instruments, n.d.g).

Technical Support

In addition to its software and hardware products, National Instruments provides the option to purchase extended service programs for all of its products. By purchasing a subscription, an individual or company gains access to individualized technical support from National Instruments’ application engineers. Application engineers are available to contact through phone and email to aid in troubleshooting most issues that customers may encounter while using National Instruments’ products, ranging from simple activation issues to determining why a sensor is producing inaccurate measurements in a unique system. In addition, National Instruments provides customers with access to previous software versions and online training when purchasing software support and system configuration, assembly, and test services when purchasing hardware support (National Instruments, n.d.e).

Markets and Industries

National Instruments serves a variety of customers worldwide in industries ranging from aerospace to robotics. These customers use National Instruments’ software and hardware solutions to increase productivity and performance as they develop technologies that impact millions of individuals worldwide in numerous aspects of their lives (National Instruments, n.d.d). While it produces products in countless industries, much of National Instruments’ core products and services stem off a single market: the Test & Measurement market. As a whole:

The Test & Measurement sector offers essential test, calibration and metrology equipment, instruments, software and services used to create actionable intelligence by measuring and

monitoring a wide range of parameters in the biotech, food & beverage, energy, industrial, technology, pharmaceutical and specialty chemical industries. (Delancey Street Partners)

Currently, the Test & Measurement market is seeing exceptional growth because of increased modular instrumentation penetration, increased networking and communication advancement, and increased electronic device adoption. Experts forecast the Test & Measurement market to grow from 23.51 billion USD in 2017 to 28.98 billion USD in 2023, with the largest growth occurring in the Test & Measurement equipment market for modular instrumentation due to increased automotive production and technological advancements involving 5G solutions (Business Wire, 2017b).

Current Situation

Currently, National Instruments employs approximately 7,400 employees in nearly 50 countries, serving over 35,000 customers annually (National Instruments, n.d.c). In 2017, National Instruments saw record revenue at \$1.29 billion, up 5 percent from 2016. Further, National Instruments logged record operating profit and cash flow from operations during 2017. Revenue growth can be attributed to both hardware and software product lines. PXI and modular instrumentation products saw record revenue growth and software saw growth in new software seats and enterprise agreements, renewals, and online sales (National Instruments, 2017).

The demand for new technology and the need to test it in areas such as autonomous vehicles, 5G, and the Industrial Internet of Things spurs much of demand that National Instruments sees. Using its modular and adaptive approach to development, National Instruments is able to stay at the forefront of innovation and focus on customer needs, thereby producing successful products and value in the eyes of consumers (National Instruments, 2017).

Risks and Issues

Much of the risk that National Instruments faces involves their significant investments in new products and market acceptance of these new products. Rapid technological changes and consistent evolution of customer needs characterizes the Test & Measurement market, producing an environment where constant adaptation and new product introductions is necessary to maintain relevance and success. In the past and in the expected future, National Instruments has experienced significant delays between the announcement and availability of new products, which ultimately diminishes how well the market responds to the product. This may hinder revenue and end up costing the company due to research and development and manufacturing costs (National Instruments, 2018).

In addition, National Instruments faces significant risk in the value of the U.S. dollar versus other local currencies, a factor outside of their control. National Instruments largely maintains its manufacturing, warehousing, and distribution capacities outside of the U.S. in facilities in Debrecen, Hungary, and Penang, Malaysia. This ties a large factor in the success of National Instruments to the strength of the U.S. dollar (National Instruments, 2018). With the U.S. dollar recording its first annual decline in five years in 2017, National Instruments may face serious issues in terms of profit (Nelson, 2017).

Finally, although National Instruments reached record high revenue of \$1.29 billion in 2017, it only retained \$145 million in operating income and \$52 million in net profit (National Instruments, 2018). This is a significant decline over the last three years and indicates internal operating issues that need to be addressed for the longevity of National Instruments.

Situation Analysis

In this section, the current situation of National Instruments will be expanded upon greatly, with assessments regarding internal and external factors affecting National Instruments' success. Appropriate analysis tools will highlight key factors and issues that National Instruments is encountering, which will later foster the creation of a strategy for future success.

Business Model

National Instruments strives to be a customer-driven company by adhering to its mission “to equip engineers and scientists with tools that accelerate productivity, innovation, and discovery” (National Instruments, n.d.c). It continually strives to deliver products that help engineers and scientists address challenges in the quickest, most efficient manner possible, coinciding with the ideals and goals the company was founded on. This is evident in recent news with Subaru “using NI hardware-in-the-loop (HIL) technology to simulate actual road conditions for electric vehicle testing, eliminating environmental factors to reduce test time and costs” (Business Wire, 2018). Through ideals and efforts to produce results such as these, National Instruments truly puts its customers first and designs products with them in mind. This customer-oriented design process in combination with exceptional support for all of its products produces substantial value from the viewpoint of consumers, who are likely to be confident that National Instruments places their best interests first and will strive to create that value for every customer.

National Instruments' revenue largely results from three interconnected sources: sales from individual hardware and software products, sales from fully assembled custom systems created by National Instruments for customers, and subscriptions to National Instruments service programs for hardware products, software products, and custom systems. Unfortunately, income data was not broken down into individual categories, rather by region of sale. For 2017, National Instruments saw sales of \$504 million in the Americas, \$408 million in Europe, Middle East, India, and Africa (EMEA), and \$376 million in Asia and Pacific (APAC) regions to produce revenue of \$1.29 billion (National Instruments, 2018). While specific numbers are not available in its 10-K, National Instruments still provides some insight to the current state of its revenue sources in its annual report. National Instruments reported “PXI and modular instrumentation products had double-digit percentage year-over-year revenue growth” and saw “double-digit percentage year-over-year growth in online software sales” (National Instruments, 2017).

Value Chain

After achieving record revenue in 2017, National Instruments aims to continue delivering value to its customers in an effort to drive revenue growth even higher in 2018. Specifically, it is focusing on two separate areas to deliver this value: “delivering more value to [its] customers where [its] portfolio is most differentiated” and “the industry and application areas where [its] brand is strong”. National Instruments believes that by making this its primary focus for 2018, it will help drive revenue growth, make profitability goals attainable, and enable growth for its partners. As a secondary focus, National Instruments aims to complete its goal started in 2017 to achieve a non-GAAP operating margin of 18 percent. The goal of 2017 was to reach half of that margin and was achieved by the company. In 2018, National Instruments aims to reach the full margin of 18 percent (National Instruments, 2017).

In order to achieve its goals, National Instruments needs to levy its resources effectively to maximize the value that it receives from its operating expenses. Predictably, over half of operating expenses for the past

three years fall under sales and marketing in accordance with National Instruments’ commitment to engaging with its customers to understand its market and the products the market desires (National Instruments, 2018). This aligns with its goal to deliver more value to its customers in differentiated areas and is likely to continue to produce positive results in the near future.

Additionally, National Instruments reinvests heavily, upwards of 30 percent in the past three years, in its research and development department to make the insights it gains from sales and marketing a reality for its customers (National Instruments, 2018). In doing so, National Instruments remains an innovative competitor in the market and continues to invest its capital in its customers, producing substantial value for them. Figure 2 below displays a holistic view of National Instruments’ operating expenses and major costs, providing a visual representation of the magnitude that National Instruments invests into ensuring its customers are provided with sufficient resources and products to be successful.

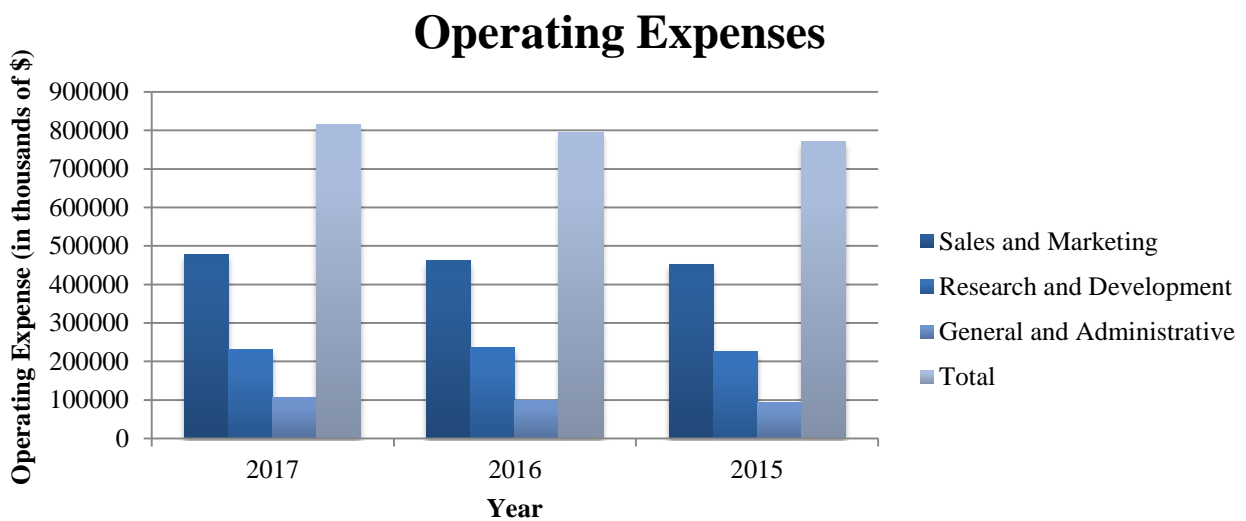


Figure 2. Operating expenses for National Instruments for the past three years.

Internal Analysis

To assess a business’s current state as accurately as possible, analysis tools such as a SWOT analysis are often used. For internal purposes, this section will focus on the strengths and weaknesses of SWOT.

The largest strength that National Instruments possesses is its software-based approach to instrumentation. While other companies produce instrumentation hardware that is compatible with analysis software, they do not design the hardware with software in mind. National Instruments, however, designs its hardware concurrently with its software, prominently LabVIEW. This has produced “over 13,000 instrument drivers, support for hundreds of NI measurement products, and connectivity to hundreds of sensors” and allowed customers to “leverage decades of NI software development to build complex systems and solve a wide range of engineering challenges” (National Instruments, 2017). No other company can claim such dedication to the combination of hardware and software.

Additionally, National Instruments’ phenomenal customer support is unrivaled by competitors in the Test & Measurement market. National Instruments employs dedicated applications engineers whose main responsibility is to provide technical support to customers, including troubleshooting systems and issues

in unique configurations. Most competitors do not provide such services, with the only known exception being Agilent Technologies, but the extent to which it offers technical support is vague. Agilent states it “is committed to helping you succeed with your application” and customers can call or email with questions, but to what degree is not as clear as the service programs outlined by National Instruments (Agilent, n.d.). Combined together, these strengths double as distinctive advantages that National Instruments maintains over its competitors.

It boasts impressive strengths, but National Instruments faces pressing weaknesses as well. The largest of which is apparent in its finances, particularly the operating and net incomes. Despite achieving \$1.29 billion in revenue in 2017, National Instruments only retained \$145 million in operating income and \$52 million in net income. This is the lowest net income in the past five years and National Instruments has trended downwards since 2014 where it retained \$126 million in net income (National Instruments, 2018). While the company is still profitable based on its net income, it does not bode well to be declining in an industry where a few failed products can introduce losses to a company’s bottom line. Figure 3 below displays the decline of net income in comparison to operating income.

Operating Income vs. Net Income

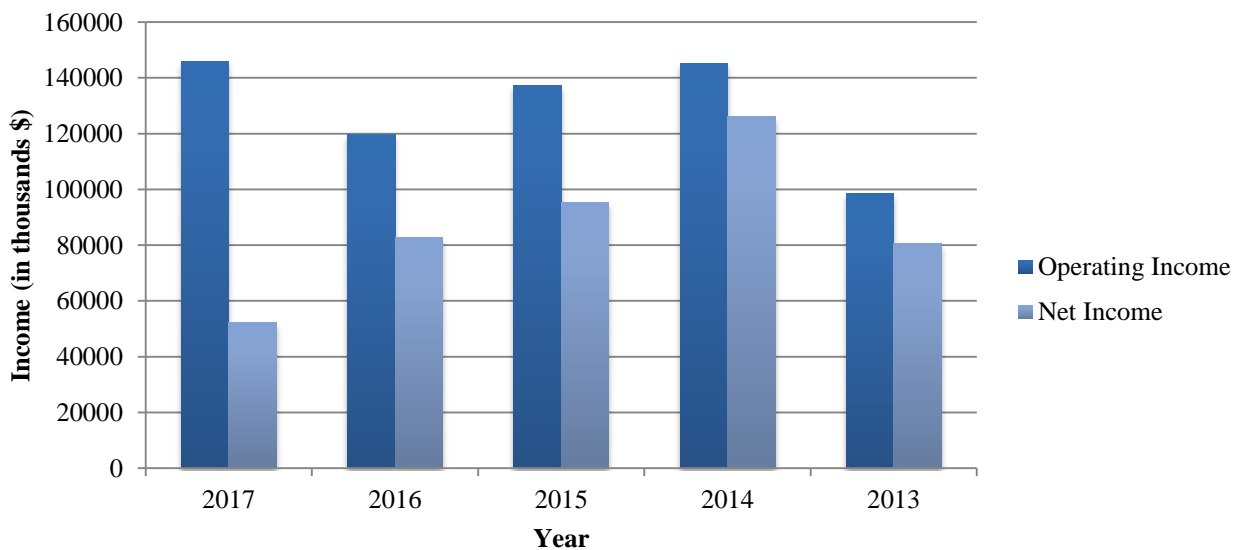


Figure 3. Operating Income vs. Net Income for National Instruments for the past five years.

Although its net profit is decreasing, National Instruments maintains high stability with its established intellectual capital and assets, such as its hundreds of product patents, and dedicated workforce of over 7,400 employees. Further, it has successfully transitioned CEOs recently and not faltered. In 2016, Alex Davern replaced Dr. Truchard as CEO after 40 years of leadership. Dr. Truchard pioneered virtual instrumentation through National Instruments and Alex Davern has eagerly stepped up to maintain this vision and continue to empower engineers and scientists to be more productive and innovative. He is prioritizing accelerating growth from system-level sales, optimizing broad-based business and delivering operating advantage, a direction that National Instruments needs to increase its earnings (National Instruments, 2016).

External Analysis

Continuing the SWOT analysis started in the section above, we will now discuss the opportunities and threats facing National Instruments.

One of the largest opportunities National Instruments currently has is in the design of 5G test and measurement tools. National Instruments “is responsible for making the hardware and software for testing and measuring 3G, 4G LTE and 5G”. In doing so, it is serving “customers such as Qualcomm and Qorvo, carrier equipment providers like Samsung, carriers such as AT&T ... basically everyone” (Moorhead, 2018). Certainly, National Instruments has the capability to lead the development of 5G and profit off this desirable evolution in mobile data.

In terms of threats, National Instruments faces potential issues in its massive product catalog. As it identifies new issues that engineers and scientists face, National Instruments begins to develop new products to solve the problems. However, this can saturate the strength of other core products when shifting the focus to newer solutions. This provides competitors with opportunities to steal business away from National Instruments in areas that it is not currently focusing on. A parallel can be drawn between Amazon and National Instruments in that each maintain massive product catalogs, opening up the possibility to lose business. The largest difference, however, is that National Instruments does not possess the capability to undercut competitors in the same manner as Amazon, which largely contributes to its success in maintaining such a large catalog.

Another useful tool to evaluate National Instruments’ position in the Test & Measurement market is Porter’s Five Forces. For the Test & Measurement market:

- Threat of New Entrants: Low
- Threat of Substitutes: High
- Bargaining Power of Buyers: High
- Bargaining Power of Suppliers: High
- Competitive Rivalry: High

As evident from Porter’s Five Forces, National Instruments is in a highly competitive market. As technological trends continue to evolve, the need for new test and measurement solutions increases and only companies that can stay on top of current trends will remain successful long-term. Further, numerous companies make up the market, with the top competitors including Agilent Technologies, Ametek, Fortive, Keysight Technologies, and National Instruments (Delancey Street Partners, 2018). This means that for nearly every product that National Instruments produces, there is some form of a substitute from a competitor in the market. Thus, it is critical to maintain awareness of the current trends of the market and provide appropriate, valuable solutions to be successful in the Test & Measurement market.

The Test & Measurement market is displaying several favorable trends including “the automation of laboratory instruments and test equipment” and “disruptive technologies in the T&M sector that enable real-time improvements to manufacturing operations” (Delancey Street Partners, 2018). Further, as mentioned previously in the Background and Issues section, the Test & Measurement market is expected to grow from \$23.51 billion in 2017 to \$28.98 billion in 2023, with the largest growth occurring in the

test and measurement equipment market for modular instrumentation due to increased automotive production and technological advancements involving 5G solutions (Business Wire, 2017b).

Market trends can be further established with the aid of an analysis tool such as the PEST analysis. For the Test & Measurement market, the two most prominent categories are political factors and technology factors. Politically, the Test & Measurement market benefits greatly from compliance from government agencies. For example, the EPA, FAA, and OSHA establish regulations that provide protection and safety benefits. In fact, “according to a 2016 study by the National Association of Manufacturers (NAM), there was an average of 3,300 new regulations issued each year between the years 2000 and 2014” (Delancey Stree Partners, 2018). This provides an environment where companies need to test products more thoroughly before release, thereby increasing the need for the Test & Measurement market. This further ties in to technology factors. As new technologies are pursued and new products are developed, these products need to be tested before release, thereby increasing the need for innovation and offerings from the Test & Measurement market.

Strategy Goals and Evaluation Criteria

Being that National Instruments is producing record revenues both company-wide and in key product areas, the largest area that it can improve in is increasing its operating income and net income. In order to accomplish this, it should take on a strategy that both reduces operating expenses and increases net sales. While this is inevitably a standard goal for any company, National Instruments is in a unique position in the Test & Measurement market where product turnover and introduction occurs at an exceptionally high rate. With constantly changing customer needs and a mentality to become involved in every new trend, it is easy for a company to spread itself too thin. This results in higher sales & marketing and research & development operating expenses with marginal capital gains as opposed to investing a substantial portion of resources into a singular industry or product that will provide higher margins.

Thus, the strategy alternatives determined in this paper should achieve two main objectives:

1. Reduce operating expenses
2. Increase net sales

Strategy alternatives will be judged for success based on the following criteria:

- Sales and Marketing expenses reduced by 8% over the next two years
- Research and Development expenses reduced by 4% over the next two years
- More Research and Development expenses diverted to a particular industry
- Increase net sales in each region by 5% over the next two years

Strategy Alternatives

Based on the strategy goals outlined in the previous section, it is likely that National Instruments would need to make changes to its approach to its product line or product investments to accomplish both objectives. While it would be possible for National Instruments to reduce operating expenses without changes to its product line or product investments, increasing net sales concurrently at a rate of 5% is

unlikely without incorporating some measure of changes. All considered alternatives were not restricted to this mindset, but those with the greatest likelihood of success incorporated this element to some degree.

Potential Alternatives

One possible strategy that National Instruments could pursue is increasing its investments in the development of 5G testing technologies. Currently, National Instruments leads the Test & Measurement market in developing hardware and software to test 5G networks effectively. However, National Instruments also prefers to maintain diversity in its products, ensuring that “no industry comprises more than 15% of revenue”, so it is unlikely that the company is allocating as many resources as it could to 5G developments (National Instruments, n.d.c).

Another potential strategy that National Instruments could pursue is increasing its investments in the development of Internet of Things (IoT) and Industrial Internet of Things (IIoT). Many industrial companies are drawn to the idea of the IoT “because it opens up a new world of business, operations and process improvement opportunities without requiring an entirely new set of technology investments”. However, most companies do not know how the IoT can improve their current business practices. National Instruments has attempted to bridge that gap by opening an IIoT lab on its Austin, TX campus in 2017. Initially, the lab will focus on “advanced control for manufacturing, asset monitoring for heavy equipment, and microgrid control and communication” (Greenfield, 2017). This introductory lab could be the start of an entirely new set of products developed by National Instruments to help companies transition current systems into ones involving the IoT or IIoT.

Another prospective strategy that National Instruments could pursue is to reduce the amount of new products that it is currently researching or developing in exchange for increased focus on existing products. While this may hinder its ability to compete in new markets or areas as new trends emerge, it would allow National Instruments to fine-tune more of its products and capitalize on reduced operating costs. By focusing on existing products, there is a smaller need for Sales and Marketing expenses as customers are already aware of the products. Further, Research and Development costs could be reduced and allocated to improving existing products, which would cost less than developing new products.

Alternative Evaluations

In the case of increasing investments in the development of 5G testing technologies, it is likely that the strategy will be either successful, or nearly successful by the evaluation criteria previously specified. Currently, National Instruments is the leader in producing the hardware and software for testing and measuring 5G and has collaborated with countless leaders in the development of the 5G network (Moorhead, 2018). With such a commanding presence in the industry, expanding product offerings and partnerships with emerging leaders would be simple and fully feasible. This, in combination with experts estimating the 5G infrastructure market to be valued at \$2.86 billion by 2020 indicates that this alternative would be successful (Business Wire, 2017a).

If National Instruments were to implement the strategy of increasing investments in the development of IoT and IIoT technologies, it is likely the strategy will nearly meet the success criteria. Unlike its position in the 5G market, National Instruments does not currently lead the market in the development of test and measurement solutions for IoT and IIoT applications. Opening the IIoT lab in 2017 in combination with its current IIoT offerings puts National Instruments in an advantageous position to expand its influence in

the IoT and IIoT market, but is not as solid as its leading position in the 5G market. Other competitors, such as Keysight Technologies, offer competitive test solutions that rival those of National Instruments, producing a threat of substitutes for National Instruments. However, the IoT market is forecasted to reach nearly \$1.4 trillion by 2021, so a leading position in the market may not be necessary to be successful (IDC, 2017). Overall, it is uncertain whether increasing investments in the development of IoT and IIoT technologies will produce a successful strategy due to uncertainties within the market and of the success of new products.

Reducing the amount of new products that it is currently researching or developing in exchange for increased focus on existing products is unlikely to be successful based on the evaluation criteria. While this strategy will certainly reduce operating expenses, it is not expected to increase net sales, one of the two main objectives for the strategy. By reducing the development of new products that customers do not own and decreasing the visibility of current products through Sales & Marketing cuts, net sales will struggle to increase or, more likely, decrease. Even the reinvestment in existing products will not prevent this from occurring, as existing customers are not likely to purchase new products if their current products already function as desired. Therefore, due to the unlikelihood that National Instruments will be able to increase its net sales using this strategy, it is unlikely to be successful based on the evaluation criteria.

Strategy Recommendations

Based on the evaluation of each strategy alternative developed above, a formal recommendation for the strategy of National Instruments has been determined: increase investments in the development of 5G Test & Measurement technologies. This strategy was ultimately chosen due to its high chances for increasing net sales while also providing the means to scale back operating expenses from other product lines. The implications of this plan at relevant strategy levels will be explained in detail below.

Inter-organizational Strategy

Currently, National Instruments leads the 5G Test & Measurement market, being “responsible for making the hardware and software for testing and measuring ... 5G, ... carrier equipment providers like Samsung, carriers such as AT&T, and researchers at higher education institutions – basically everyone” (Moorhead, 2018). Further, National Instruments simplifies the 5G testing process by taking “three, complex, uncoordinated steps with multiple software tools and incompatible hardware and [combining] it into an integrated, manageable, contiguous workflow with compatible hardware” (Moorhead, 2014). Competitors have attempted to improve their point products in any one of the three steps, but none have attempted to develop a process similar to National Instruments. This provides National Instruments with a substantial advantage when designing its 5G solutions, thereby minimizing any pressure to compete when comparing itself to its competitors.

However, National Instruments does not only need a strategy to deal with its competitors, but also one to engage with leading developers in the 5G market. As mentioned previously, National Instruments has collaborated with organizations such as Samsung and AT&T by providing them with the necessary test and measurement tools to develop new 5G technologies. In order to maintain its status as the leader in 5G test and measurement market, National Instruments should aggressively pursue any significant new entrants into the market before its competitors, which should be straightforward given its status and history in the market.

Corporate Strategy

National Instruments' corporate strategy when pursuing a plan to increase investments in the development of 5G technologies is clear: it will be in the business of 5G Test & Measurement technology. With 5G being the "next big thing", the outlook for the 5G infrastructure market is positive. It is "estimated to be valued at [\$2.86] billion in 2020 and it is further expected to reach [\$33.72] billion by 2026". Major factors influencing this growth include "increasing demand for mobile data services, rising importance of software implementation in a communication network, the growth of machine-to-machine (M2M) communication in industries, and growing demand for high speed and large network coverage". Growing demand for 5G consumer devices such as smartphones and tablets will likely further this growth, specifically in North America (Business Wire, 2017a). With the potential for billions in revenue, current leaders in the 5G infrastructure market are likely to continue to invest large amounts of money into product development, which coincides with an increased need for a company such as National Instruments to provide the necessary test and measurement equipment. Consequently, National Instruments is poised to profit greatly from this industry and be able to achieve the targeted increase in net sales to meet the success criteria.

Business Unit Strategy

As aforementioned, National Instruments currently leads the 5G Test & Measurement market, which is the market it will be competing in as defined in the Corporate Strategy section. Being that it already leads the market, the best strategy is to continue its current course of aspiring to the National Instruments mission to "[equip] engineers and scientists with systems that accelerate productivity, innovation, and discovery". However, rather than limiting investments to ensure that "no industry makes up more than 15 percent of revenue", National Instruments should heavily invest in its current position in the 5G Test & Measurement market (National Instruments, n.d.c). As mentioned in the Corporate Strategy section, the outlook for the 5G infrastructure market is positive, with a potential valuation of \$2.86 billion by 2020 (Business Wire, 2017a). With such a strong opportunity to increase revenue, National Instruments surely should reconsider its current investing practices and redirect some funds for the time being. Figure 4 below displays Research and Development costs for National Instruments over the past five years, and illustrates that with the amount National Instruments annually spends, it can surely invest additional funds into the 5G Test & Measurement market at the expense of a lesser investment opportunity.

In addition to modifying its investment practices for Research and Development, National Instruments can incorporate cuts to Sales and Marketing expenses. By investing heavier into a singular industry where it is widely known to be the best, National Instruments can reduce its marketing efforts with minimal negative effects to product coverage or sales.

Research and Development Expenses

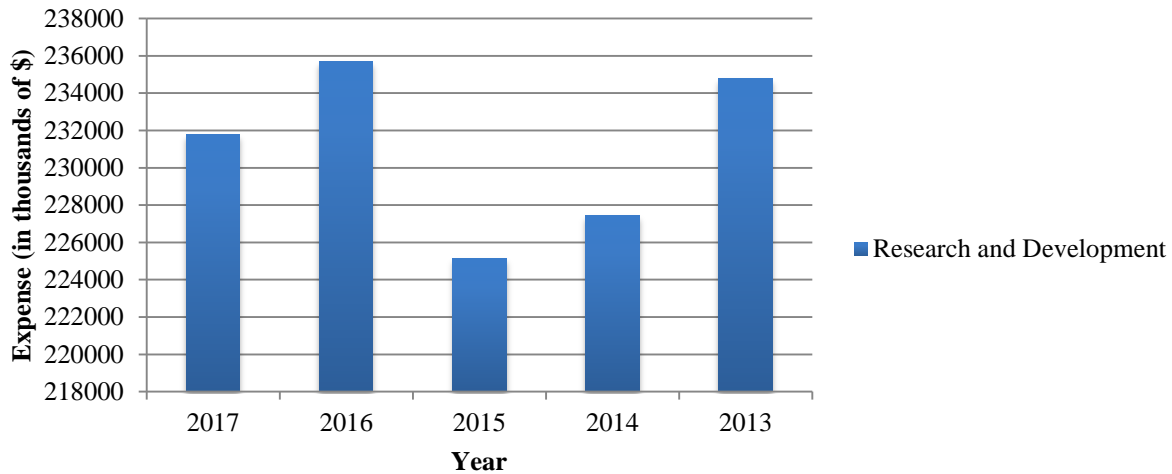


Figure 4. Research and Development expenses for National Instruments for the past five years.

Other Considerations

Despite strong strategies at multiple levels, there still exists the unknown variable of how invested National Instruments already is in the development of 5G technologies. Being the current market leader, it is likely the National Instruments is heavily invested already (there are no reports to neither confirm nor deny this hypothesis), which may make additional revenue stem from a smaller potential pool of unattained wealth. This would make an increase in net sales more difficult and thus run the risk of not meeting the evaluation criteria.

Recommendation Justification

Despite this potential issue, based on National Instruments' current position as leader of the 5G Test & Measurement market and the positive outlook of the market as a whole, it is in a strong position to meet the success criteria outlined in the Strategy Goals and Evaluation Criteria section. Restructuring its investment plans in Research and Development will place priority into a rapidly growing market that will produce substantial profit while also providing the opportunity to incorporate cuts to large expenses.

Implementation Plan

In order to implement the strategy outlined above successfully, National Instruments will be following a two-phased schedule to spread out the changes in an even manner. Each phase will be identical, similar to National Instruments' initiative to bridge half the gap of its non-GAAP operating margin target of 18% in 2018, to ensure reachable goals while working towards the success criteria. Sales & Marketing reductions will be by half of the overall goal each year. Research & Development additions will be a restructuring of the current plan, which has taken 10% from other Research & Development endeavors (5% per year). 6% of this will be redistributed to 5G Test & Measurement initiatives over two years while the other 4% will be taken away altogether to achieve the Research & Development reduction goal.

The schedule will occur as follows:

- Year 1 – 2018
 - Reduce Sales & Marketing expenses by 4%
 - Increase Research & Development expenses in 5G Test & Measurement initiatives by 3%
- Year 2 – 2019
 - Reduce Sales & Marketing expenses by 4%
 - Increase Research & Development expenses in 5G Test & Measurement initiatives by 3%

Overall, the implementation plan will produce gradual restructuring in National Instruments’ operating expenses, reallocating current Research & Development resources into the targeted 5G Test & Measurement development initiatives, while also reducing expenses in both the Sales and Marketing and Research and Development sectors.

Contingency Plan

With any decision comes the possibility of failure. The largest concern for this strategy recommendation is that the increased investment into development of 5G Test & Measurement technology will not produce adequate net sales to make up for the decreased investment in other products and potential net sale losses from decreased Sales and Marketing expenses. While this does not necessarily mean that National Instruments will be operating in the red, it can certainly diminish the already low net income further.

In the event that increasing investments in the development of 5G Test & Measurement technologies is unsuccessful, National Instruments needs to be ready to reverse the restructuring changes described in the implementation plan. If the investments prove unsuccessful, it is a clear indicator that National Instruments’ previous expense allocation was more effective and all changes should be reverted to their prior state. Unfortunately, this will result in additional losses in the form of lost Research and Development expenses and decreased net sales because of decreased Sales and Marketing expenses.

With this plan in mind, a leader can be prepared to react in the event that he or she senses the outlook of the recommendation becoming poor. This trigger point will likely occur at the beginning of the second year in either Q1 or Q2, where it will be clearly evident that the increased efforts in 5G Test & Measurement technologies is not working. One will be able to determine this due to the rapid development environment that the 5G market is currently experiencing. New developments are consistently being made, with initial 5G deployments scheduled for the end of 2018. Thus, if National Instruments is not seeing noticeable differences in net sales by 2019, the strategy is likely failing.

Conclusion

Since 1976, National Instruments has made it its mission to equip engineers and scientists with systems that accelerate productivity, innovation, and discovery. The company pioneered virtual instrumentation in a software-based approach to instrumentation, gradually developing a platform that tightly integrates hardware and software to simplify data collection, measurement, and testing. In 2017, National Instruments attained record revenue of \$1.29 billion, but fell victim to high operating costs and recorded a net income of only \$52 million. With its current leadership position in the 5G Test & Measurement market, National Instruments is poised to become the key leader in an industry deemed “the next big thing” that is projected to be valued at \$2.86 billion by 2020 and \$33.72 billion by 2026, but requires restructuring within its operating expenses to capitalize on this opportunity fully.

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