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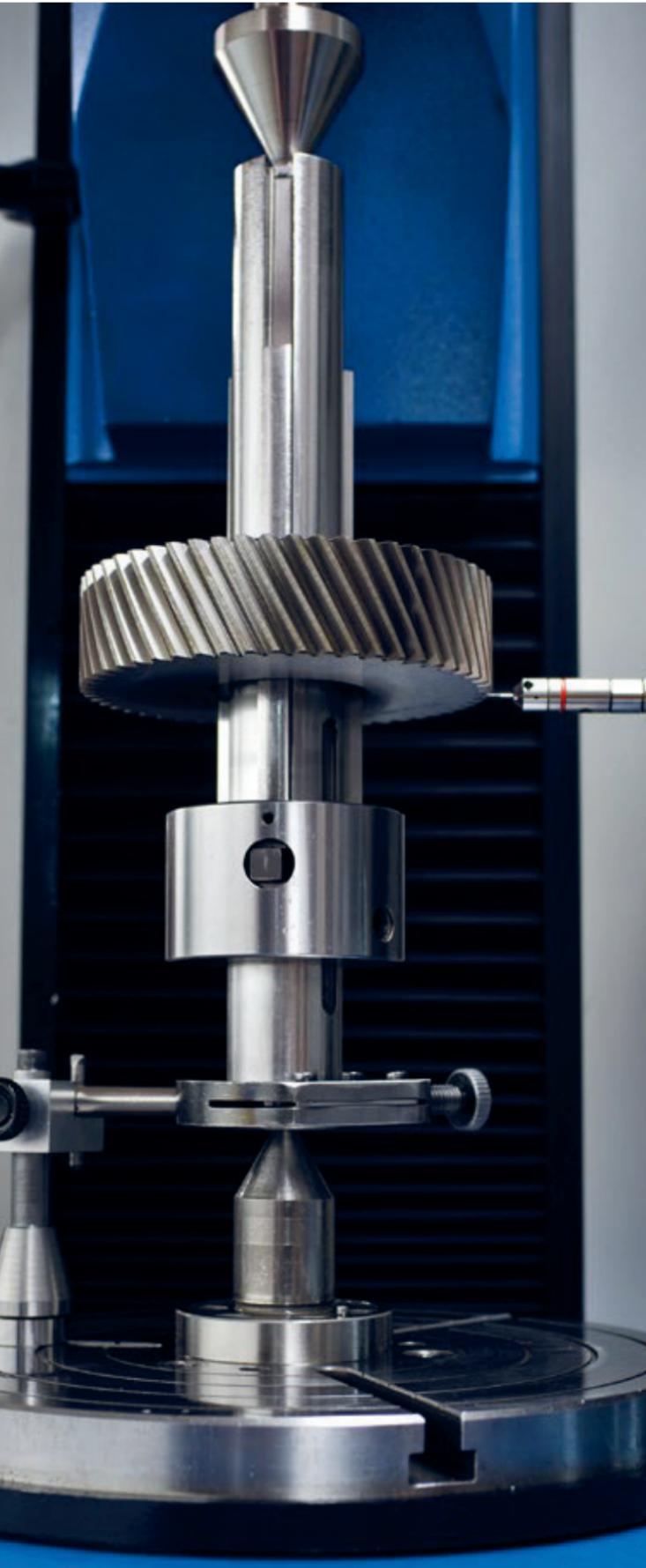


Table of Contents

1.0 Introduction	4
2.0 History	6
3.0 Structure of Gear Motions	7
3.1 Executive management	7
3.2 Finance	9
3.3 Manufacturing	9
3.4 Engineering	10
3.5 Material management	10
3.6 Quality	10
3.7 Sales and marketing	10
4.0 Customer Segmentation	11
5.0 Market Expansion Strategy	12
6.0 Global And Domestic Gear Market Scenario	12
7.0 New Product Development	14
8.0 Game Changing Patent	17
9.0 Characteristics of The Inventor	18
10.0 Case Questions	18
11.0 References:	19

1.0 Introduction

Gear Motions Inc. is a leading gear manufacturing company in the United States and is popularly known for designing, manufacturing, and delivering customized gear components. Headquartered in Syracuse, NY, Gear Motions consists of three divisions that are all located in New York State: Niagara Gear Division, Nixon Gear Division, and Oliver/Pro-Gear Division (see Pictures 1 and 2). It manufactures different types of gears through leveraging state-of-the-art manufacturing technologies and networks of suppliers, employees, and customers.

Gear Motions, having a sales volume of approximately \$16 million, is completely employees-owned company exemplifying the dedication of all of its 93 employees to go beyond what customers expect, visualizing the customers' gear thinking, delivering high-precision gears, and involving in all the stages of the operations. Thus, Gear Motions becomes an example company in the gear industry for equally valuing employees and customers and possesses high capabilities to satisfy the needs of any industry demanding gears, ranging from small to large diameter, for any applications.

The slogan, "Precision in Motion", is a quality principle integrated and ensured with all the processes and products Gear Motions manufactures and delivers to its customers. Gear Motions has established ethical environment for their employees, ensures transparent communications among employees, utilizes data-driven decision making, appreciates employees' engagement, and empowers employees. Gear Motions promotes such values to achieve its vision of being a "most sought-after company to work for and do business with". Due to these values, gear market research firms includes the production capabilities of Gear Motions for global gear market analyses.

Picture 2. Locations of three plants in NY

Picture 1. Locations of three plants in NY



Picture 1. Corporate office located in Syracuse, NY

Picture 2. Corporate office located in Syracuse, NY



2.0 History

1960	Mr. Samuel T. Haines acquired Rawling Gear that produced custom gears and served New England region with 10 employees
1973	Mr. Samuel A. Haines officially joined Rawling Gear to purchase 'Turn Around' specialty gear shops
1973	<i>Gear Motions</i> was established
1973	<i>Gear Motions</i> acquired the first gear manufacturing plant in the Buffalo and Niagara regions – Oliver Gear, Buffalo, NY, after witnessing its capability of producing 10 feet diameter gears
1978	<i>Gear Motions</i> acquired the bankrupted Nixon Gear, Syracuse, NY; this acquisition paved a way for <i>Gear Motions</i> to access Midwest and Mid-Atlantic states
1980	<i>Gear Motions</i> created Plastic Gearing Services Division to market high strength plastic gear products
1988	Gear Supply and Broaching was acquired by <i>Gear Motions</i>
1992	Nixon Gear Division plant was started functioning in the 45,000 ft ² facility located in Milton Ave, Syracuse
1996	Nixon Gear Division received ISO 9002 certification
2005	Transition began from privately-owned firm to employees-owned firm
2008	Dean Burrows, President & CEO, joined at <i>Gear Motions</i>
2010	Transition was over and <i>Gear Motions</i> became a 100% employees-owned company
2010	Oliver Gear Division received ISO 9001:2008 certification
2012	Pro-Gear Inc., Buffalo, NY was acquired by <i>Gear Motions</i> , and it was integrated with the Oliver Gear Division
2012	<i>Gear Motions</i> partnered with KBE+, an engineering consulting firm, to enhance its capabilities of designing, analyzing, and testing gears and transmission systems
2014	Niagara Gear, Buffalo, NY was acquired by <i>Gear Motions</i>
2014	Niagara Gear Division received ISO 9001:2008 certification
2018	American Gear Manufacturers Association presented Lifetime Achievement Award to Mr. Samuel A. Haines
2018	Mr. Samuel A. Haines retired from <i>Gear Motions</i>

3.0 Structure of Gear Motions

Gear Motions strives to achieve its mission through the following seven different functions executed in a coordinated and cooperated fashion: 1) Executive management, 2) Finance, 3) Manufacturing, 4) Engineering, 5) Materials management, 6) Quality, and 7) Sales and marketing. The organizational structure of Gear Motions and its different divisions are mentioned in Figures 1–4.

3.1 Executive management

Executive management is a top hierarchy level of *Gear Motions*. It is responsible for formulating corporate strategy and provides financial and non-financial supports to all the functions and employees. It is also responsible for recruiting new employees and developing, appraising, and rewarding employees.

3.2 Finance

This department monitors the financial performance of the whole company at any given period and initiates necessary actions to ensure that *Gear Motions* performs its operations above and beyond the expectations of the employee owners.

Figure 1. Top-level structure of Gear Motions

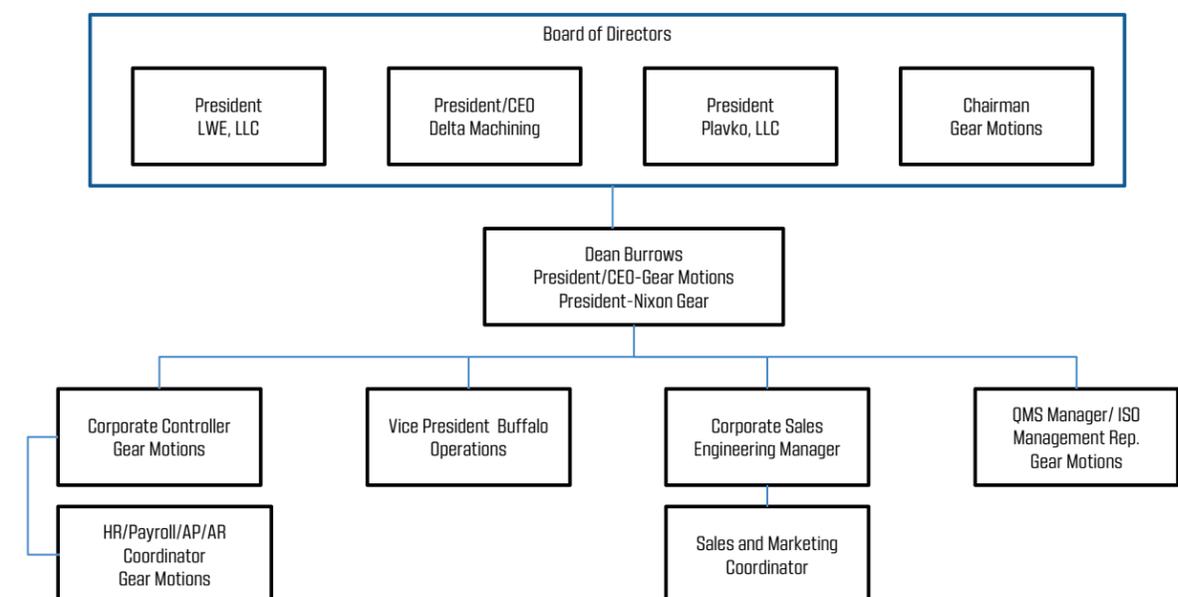


Figure 2. Structure of Nixon Gear Division

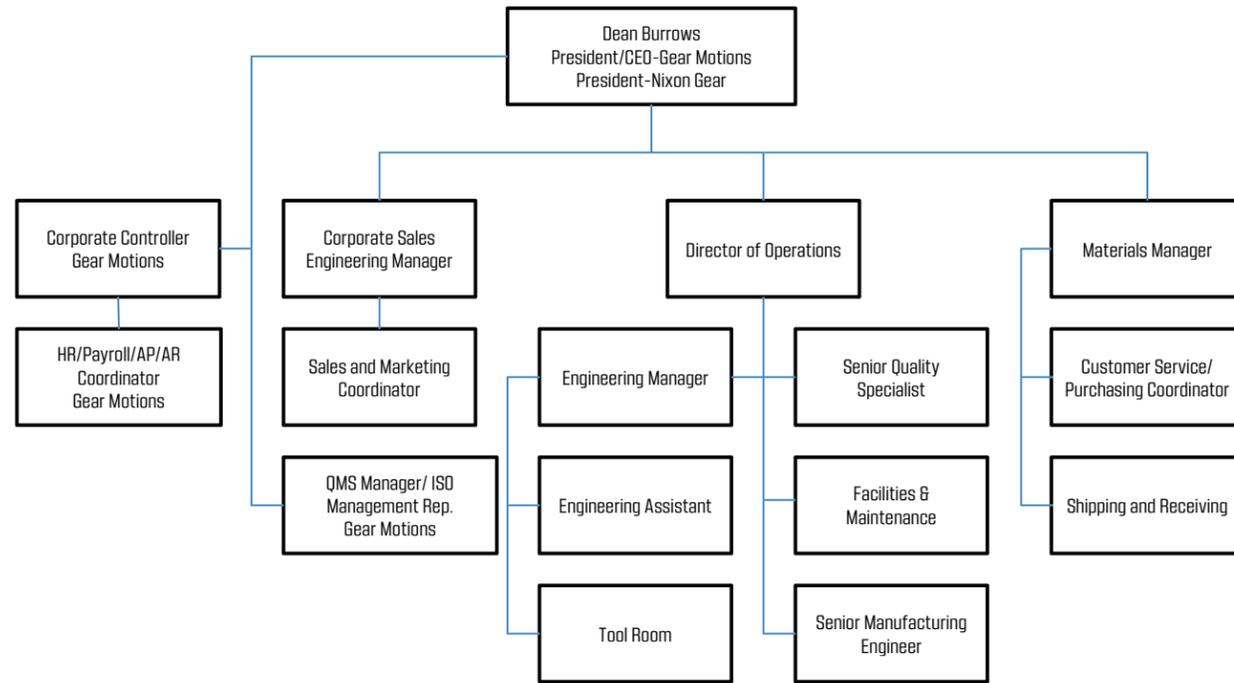


Figure 4. Structure of Niagara Gear Division

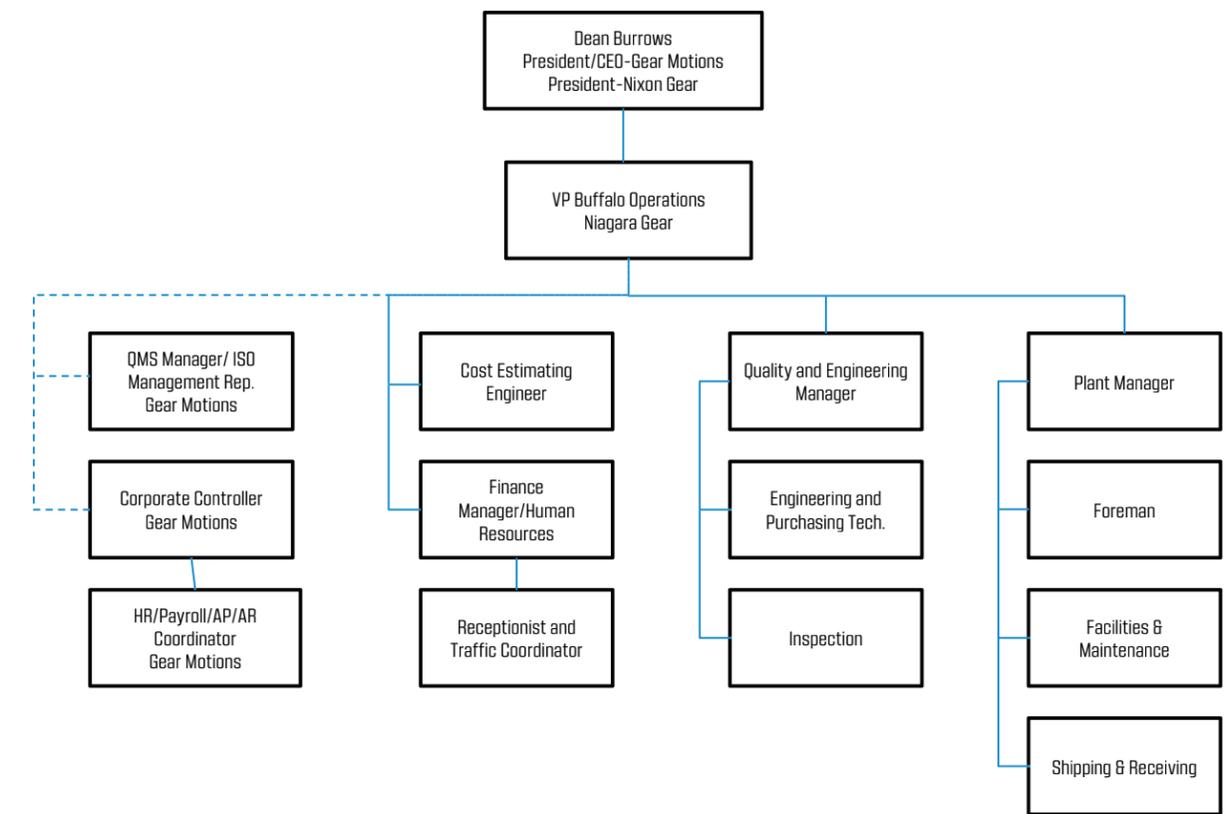
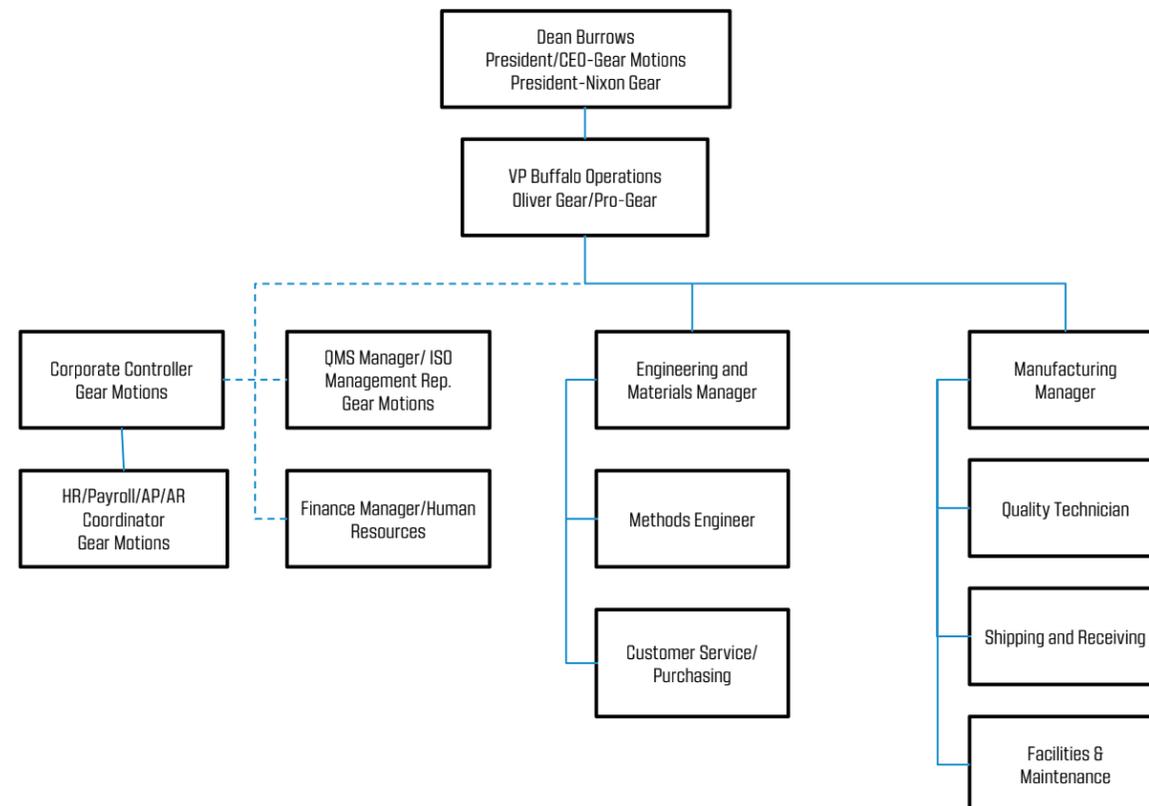


Figure 3. Structure of Oliver Gear Division



3.3 Manufacturing

Since its inception, *Gear Motions* has developed a strong and versatile capability in the area of operations management. Their manufacturing capabilities range from designing new gears to speedy delivery of gear components into the market. It has well-proven capabilities to produce the following types of gears (see Picture 3 for the models of the gears):

1. Spur gear (a straight cut gear in which the edge of each tooth in the gear is straight and each tooth is parallel to the axis of the rotation of the gear);
2. Helical gear (in this gear, edge of each tooth in the gear is not parallel, and it is used in a situation where high velocity is required);
3. Bevel gear (this gear is a cone shaped gear that is used for transmitting torque between two intersecting axes);
4. Worm drive (this drive consists of two parts: worm — a gear in the form of a screw and worm wheel — a gear which is similar to spur gear);

5. Spline (it consists of two parts: external spline — a drive shaft with ridges or teeth on it; and internal spline — the mating member that has the equal number of teeth. External spline transmits torque to the internal spline); and

6. Sprockets (it is a profiled wheel having teeth on its surface used in a drive system; Gear Motions produces roller sprocket that transmits power to other sprocket through a chain, and however, Gear Motions does not produce this chain).

The above-mentioned gears are generally produced by the combination of the following operational processes: turning, gear grinding, surface internal diameter (ID) & outside diameter (OD) grinding, gear cutting, milling and drilling, ID honing, and broaching and keyseating. *Gear Motions* performs these operations using CNC machines, lathes, and robots (see Picture 4).

Picture 3. Models of gears produced by Gear Motions



3.4 Engineering

Apart from the above-mentioned operational capabilities, *Gear Motions* has built up an excellent engineering capability that supports manufacturing functions. It has a well-versed reverse engineering team that is capable to deconstruct a gear assembly, evaluate and analyze a gear assembly, and produce this assembly using AutoCAD or SolidWorks when customers do not have design for such gear assembly. It is also very well known for their design for manufacturability, and engineering teams work together with customers to achieve their final design and to achieve mutual goals in relation to quality, cost, and delivery. Speedy delivery of prototype is another capability of *Gear Motions* that is highly essential for an industry engaging in producing customized products.

3.5 Material management

This department focuses on devising procurement plans, managing inventory, developing relationships with suppliers, offering developmental programs for suppliers, identifying new suppliers for raw materials, and managing enterprise resource planning system.

3.6 Quality

Gear Motions employs inspection specialists who make sure that the production processes are in control at every stage and every department engages in producing high quality gears at low cost. It has latest equipment and testing machineries used to meet the quality expectations of its customers. Wenzel Gear Checking machine has been used to check the precision of gear in the plants (see Picture 5).

Picture 4. Robot used in the shop floor



Picture 5. Wenzel Gear Checking machine



3.7 Sales and marketing

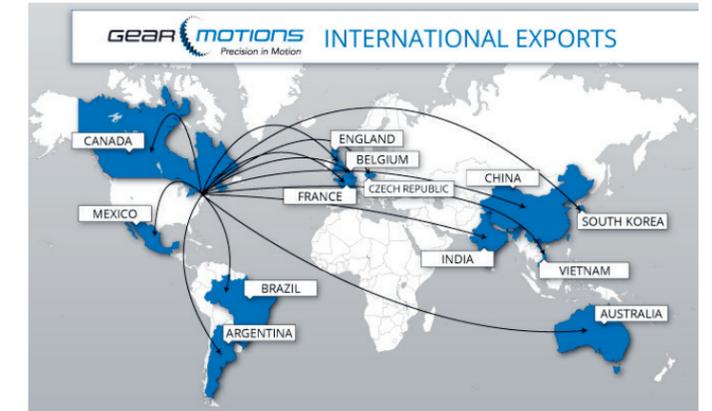
Gear Motions does not participate in mass production of gears. It is completely engaged in producing customized gear components. Sales and Marketing department is solely responsible for generating revenue for *Gear Motions*. The prime responsibility of this department is to create awareness of the kind of products it produces among customers.

It develops relationships with customers, identifies new customers/markets, and sustains its customer base. This department also provides estimation and quotes for their customer orders. In addition, it manages the website and takes care of print media related activities.

Their first phase of gear exports to Europe from the United States happened 50 years ago. At least one application of gear components could be found in the household products ranging from wall clocks to washing machines and in the automobiles ranging from bikes to cars. Going beyond these sectors, *Gear Motions* currently serves the following industrial sectors worldwide to satisfy their customer needs:

- Aerospace & Military
- Industrial & Commercial
- Material Handling & Robotics
- Medical devices
- Mining
- Oil & Gas
- Printing & Packaging
- Pumps

Picture 6. Gear Motions' global markets



4.0 Customer Segmentation

Gear Motions provides high priorities to invest significant financial resources to integrate customers with its plants. In general, they are approached by three different types of customers who often enquire about producing gear components:

1. Original Equipment Manufacturers (OEMs)

They are the manufacturing companies approaching *Gear Motions* to produce custom gears. When *Gear Motions* feels capable to meet the requirements of customers, it happily engages with customers to make custom gears. If not, it will join with its partners to satisfy the demand of these OEMs.

2. Custom replacement gear customers

They are the customers looking for spare gear components that will not be available in the market ubiquitously. These components should be made in accordance with the specifications of original gear components that most of the time, customers do not have design of such components. It is really a challenging task for *Gear Motions* to design the required gear components and then manufacture these components.

3. Stock replacement gear customers

They are the customers looking for wide variety of stock gears that are often called standard replacement gears. These gears are made for stocking purposes and used as replacement gears in the machineries. Currently, *Gear Motions* does not entertain this type of customers.

To date, *Gear Motions* completely focuses upon producing customized products. When it is involved in customization, it improves its capability of producing high varieties of products. Each product thus differs to some extent from other products it manufactures. Thus, flexibility is the biggest strength of *Gear Motions* and becomes an advantage it has so far over their American competitors such as Ontario Drive & Gear, GearTech, and Schafer Gear Works. It should be remembered that involving in customization will not reduce cost of the product. Though *Gear Motions* agrees that this strategy is not a cost effective strategy, this strategy is very unique in the gear industry, and global customers look for manufacturers to satisfy their complicated demands.

5.0 Market Expansion Strategy

Increasing market share and identifying new markets further, *Gear Motions* continually scans environment for new gear product designs that could be used for either replacing the existing gear mechanisms or for producing new machineries. Its product development specialists have competencies to generate prototypes of these designs and make final products. The important question lingering around employee owners of *Gear Motions* is “How can the company increase market share with new products, new markets, and additional capabilities?”

6.0 Global And Domestic Gear Market Scenario

Though the marketing strategies to attract OEMs and custom replacement gear customers work completely well, they have potential to enter new markets globally. This is due to the reason that various consulting firms involving in market research have predicted global demand of gears to be high. Due to stringent environmental policies developed by various governmental agencies, the automotive industry has been nowadays forced to manufacture energy efficient transmissions, and non-conventional energy sector has been triggered to produce more number of wind and solar power generating mechanisms.

Freedonia Custom Research Inc., found that global demand for gears will rise up to 6% this year, and China alone will witness two-fifth of demand growth due to increase in the usage of motorized vehicles (Freedonia Group, 2019). It is also mentioned that North America has the second-largest automotive gears market industry due to huge customer base and their disposable income. According to Global Info Research Study (2019), the global gear market will grow from \$172.6 billion to \$214.7 billion in the year 2024. This value is expected to be \$320 billion by the end of the year 2026 (Fact.MR, 2017). According to Technavio, an UK-based market research firm, the value of global

gearbox industry would be \$49 billion in the year 2022, and the value of global industrial planetary gearbox market would grow up by \$3.1 billion in the year 2022 (Technavio, 2018a, 2018b; see Tables 1 and 2 for more details).

Focusing on United States gear industry, IHS Markit and American Gear Manufacturers Association (AGMA) predicted that demand of gear in the industries is growing up this year. However, disruption in the supply chain could be a factor in the coming years to lower the gear demand in the American industry (IHS Markit, 2018). Table 3 shows the value of gear booking, shipments, demand for gears, and imports and exports of the American gear industry (in \$ millions).

Competition is very strong in the American gear industry that also currently has difficulties of locating skilled labors to produce products. Gear Technology's annual survey indicates that 85.8 per cent of gear manufacturers are optimistic about their competitive ability in the next five years. This survey also reported that this percentage was about 83 per cent in the last two years (Gear Technology, 2019). These manufacturers also look for lightweight and composite gears for high strength applications nowadays.

Table 1. Global industrial gearbox market in the year 2018–2022 (Source: Technavio 2018a)

Role of Asia Pacific Region	Specific Gearbox	Compound Annual Growth Rate	Factors to be considered
This region would be a major revenue generating region for worm drive gearboxes until 2022	Planetary gearboxes rule the global industrial gearbox market with 40% share in Europe, Middle East, and Africa	4%	Declining cost of gearboxes used in wind power; Industrial automation is growing up

Table 2. Global industrial planetary gearbox market 2018–2022 (Source: Technavio, 2018b)

Role of Asia Pacific Region	Industry dominated	Compound Annual Growth Rate	Factors to be considered
This region would be a major revenue generating region for planetary gearboxes until 2022	Process industry	5%	Oil and gas upstream activities are rising up

7.0 New Product Development

Whenever a company involves in introducing new products into the market, engineering and design team specialists should work hard to bring the design into a real product. The main tasks of this team include: evaluation of functional specifications (visualizing how all the elements of the product works); evaluation of product specifications (visualizing how all the components of the product will be made by changing various materials' properties); review of design (ensuring that this design is the best way to meet customer demand); and testing the product in the market (analyzing the gap between the product characteristics and customer expectations). Gear Motions has its own engineering teams that are capable to generate new designs and to transform such designs into the final product.

Table 3. United States gear industry forecast (Source: IHS Markit, 2018)

Year	2015	2016	2017	2018	2019	2020	2021	2022
Total bookings	2,715.1	2,431.7	3,504.2	3,571.1	3,626.1	3,637.4	3,449.3	3,334.8
Total shipments	3,206.8	2,787.6	3,263.3	3,458.3	3,652.1	3,684.0	3,514.4	3,277.0
US Exports	2,051.3	1,847.3	1,920.4	1,959.7	1,935.1	1,942.7	1,972.4	2,024.8
US Imports	3,639.9	3,263.3	3,431.8	3,803.9	3,929.6	3,906.9	3,804.0	3,895.7
Demand in each manufacturing sector								
Industrial machinery	278.3	283.1	318.9	337.5	351.9	349.1	325.5	307.4
Construction equipment	254.3	205.4	264.4	279.3	297.7	295.6	269.0	252.3
Farm machinery	718.4	629.3	731.2	780.2	820.9	822.7	784.4	744.7
Material handling & service equipment	1,332.4	1,253.4	1,486.6	1,710.8	1,832.8	1,821.2	1,697.2	1,611.3
Machine & other tools	651.7	566.0	624.9	669.3	695.1	688.2	637.5	613.6
Turbines & power transmission equipment	577.2	456.1	499.3	549.7	590.1	572.6	518.5	488.0
Oil & gas field equipment	207.7	135.6	193.8	306.7	359.5	378.0	397.7	425.1
Other mining equipment	51.9	45.2	48.4	49.1	48.6	47.7	46.9	47.2
Shipbuilding	134.5	116.6	121.4	133.1	143.1	133.5	118.7	107.7
Railroad equipment	306.1	217.1	178.5	157.3	148.3	144.4	141.8	149.8
Aerospace	282.9	295.7	307.4	329.7	358.7	395.2	408.7	400.8
Total US domestic demand	4,795.4	4,203.6	4,774.7	5,302.5	5,646.6	5,648.2	5,346.0	5,147.9

Sometimes, companies often end up with identifying a game changing product design created by individuals that can revolutionize the whole industry. In that case, it is wise to attract such individuals by showcasing various applications of their product design and agree with transforming this product design into the final product. As a result, both individual and company can achieve their goals.

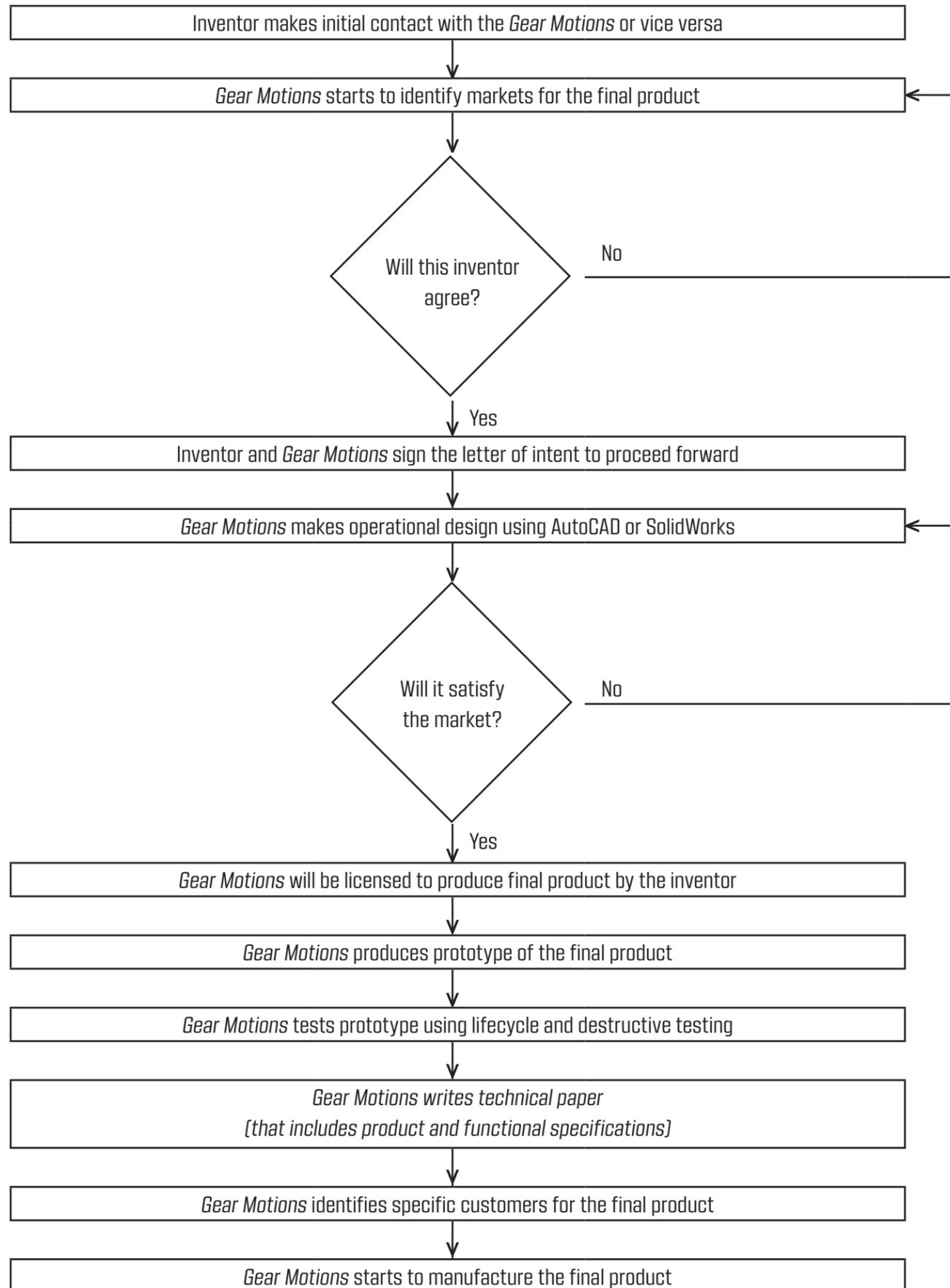
In this direction, *Gear Motions* continuously search the environment for creative gear-related design to introduce into the market. One of the place to search for such design is the database of United States Patent and Trademark Office, a division of Department of Commerce. This database contains a list of approved patents filed by various individuals and companies. Patent is a form of intellectual property of individual(s) or a company.

According to World Intellectual Property Organization, intellectual property is "creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce". The whole purpose of the system of intellectual property is to establish a conducive environment for creative and innovative ideas, to protect such ideas through laws (for example, copyright law of the US, Patent law, and trademark act), and to receive either recognition or monetary benefits. In order to assess competitors' future marketing strategy and new product development capability, identifying and analyzing patent fillings are essential.

In addition, in the case of independent individual who filed patents, efforts should be taken very quickly to attract these individuals to market their products before competitors luring them. In this direction, *Gear Motions* takes efforts to monitor patent fillings and currently, it is in discussion with one of the individuals who have got approval for their patents from United States Patent and Trademark Office. The main purpose of this discussion is to attract this individual to make prototypes of his designs and market finished products through *Gear Motions*. The flow chart (see Figure 5) shows the step-by-step procedure adopted by *Gear Motions* from the process of searching for inventor to the process of manufacturing the final product.

Generally, the individuals, who have patents, are smart and have high capability in product design. However, most of them are not business-oriented. Such endeavor of attracting this individual would require *Gear Motions* to identify different sectors in the gear industry where new applications of gear-related components could be found. As a result of this attraction, *Gear Motions* will gain a technological advantage over their competitors.

Figure 5. Processes from the identification of inventor to manufacturing the final product



8.0 Game Changing Patent

Through the continuous discussions with this individual, *Gear Motions* came to know about a patented gear assembly design that could revolutionize industries where conveyors and hoists are mainly used. In other words, marketing the final product of this design would change the direction of the game of competition. This new design will be lighter in weight, simpler to assembly due to fewer components, and not require any external source for power such as electrical or pneumatic.

Transforming this product design into a final product could help preventing backsliding problem of conveyors or hoists. Backsliding is a tendency for a conveyor belt or hoist to move in opposite direction after the whole system has been shut off. If there is a fault in the electric motor or situation of power failure, fully loaded conveyors/hoists will create huge damage to the whole system (such as materials would be spilled out throughout the work place causing damage to the property and employees). The industries, where conveyors and hoists are used, currently look for solutions to such problems. This patented gear assembly is a non-back drivable gear assembly that could be used to stop the whole mechanism in the situations where overhead hoists used in vertical positions or conveyors used in horizontal or inclined positions. There are many industries in which electric brakes are currently used to stop the entire mechanism. The following are the some of these industries *Gear Motions* identified where there are potential for this non-back drivable gear assembly could replace the electric brakes:

- 1.Theatre machinery (overhead winches and lifts)
- 2.Commercial winches
- 3.Aftermarket winches
- 4.Chain hoists/electrical hoists (Columbus McKinnon)
- 5.Agriculture/military/off-highway
- 6.Automation/robotics/conveyors/material handling
- 7.Fabrication
- 8.Medical (striker stretchers, ADA compliant devices)
- 9.Long shaft elevators/escalators

9.0 Characteristics of The Inventor

This inventor, a full-time engineer, works at a high technology company located in Syracuse, NY, which is not a gear manufacturing company. Therefore, the gear assembly design the inventor developed will be of no use at this company. He is very smart in reaching perfect solutions, and similarly, he always expect perfect solutions from others. He is highly analytical while designing the products and highly rigid in his thinking process and so his gear assembly design. He dislikes travelling and is highly passionate about his work, and so his involvement in the work is exceptional. He currently holds eight patents in which six of the patents are shared type and two of patents are his own. He receives financial resources from his sibling.

10.0 Case Questions

Student teams are required to deliver presentations on 12 April 2019 to summarize the outcomes of the following tasks:

1. Analyze the market potential of the patented gear assembly final product
 - a. In this task, teams should analyze whether this patented gear assembly can replace the existing component (for example, electric brake) in the industries or this patented gear assembly can be introduced as a completely new product for different applications.
2. Analyze various marketing channels to market this patented gear assembly final product
 - a. In this task, teams should explore various channels available to market the final product (pros and cons and outcomes and estimation of costs of each channel should be discussed).
3. Analyze which countries would be good for marketing this product.
 - a. In this task, teams should analyze various known international market situations for gear industries; propose two top most countries conducive for introducing this final product; and compare these two industries with North American gear industry.
4. List the strengths of Gear Motions
 - a. In this task, students should explore both internal and external environment of *Gear Motions* to figure out the strengths of *Gear Motions*. These strengths will be highlighted by *Gear Motions* during its discussion with the inventor (assume that the inventor does not know anything about *Gear Motions*).
5. Analyze various other factors to be considered to license the product
 - a. In this task, teams should deeply analyze the prevalence of various factors (for example, product, inventor, and finance related factors) that will facilitate *Gear Motions* to consider for licensing this product from the inventor.

The corporate challenge is organized by the director of Experiential Education **Amr Swid, PhD**. If you have any questions related to your team members, organization, and assigning a faculty advisor please reach out to him at: aswid@nyit.edu.

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Acknowledgement

Dr. Amr Swid, Director of Experiential Education of School of Management and Dr. Birasnav Muthuraj, Director of Corporate Challenge acknowledge and thank NYIT INFORMS Student Chapter for its efforts in assisting and attending the events of the corporate challenge and supporting for the success of this

If student teams have any questions, team leaders can email the questions to the case contributors Birasnav Muthuraj, PhD or Dean Burrows (contact details are mentioned below) and share the responses with other team members.

competition. We appreciate the efforts and contributions of NYIT INFORMS Student Chapter. We thank corporate challenge judges, Professors Joshua Bienstock and Colleen Kirk, and faculty mentors of all the student teams for their efforts and contributions to the success of this competition.

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Some students participated in the corporate challenge 2019

