Thermoform Engineered Quality™

A Complete Guide to TEQ's Multi-National Manufacturing Capabilities

Comprehensive Supply Chain Network Solutions

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Introduction

At TEQ, we deliver innovative and sustainable design, engineering and manufacturing solutions to the medical and commercial markets for thermoformed packages and specialty products.

At the heart of our business is a team of talented experts driven by one passion—to exceed our customers' expectations in everything we do. And, from our state-of-the-art technology, to our many years of experience, to the quality of the partners we work with, we have what it takes to deliver on this passion. Time and again, we'll go to great lengths to bring clients' ideas to life—on time, on budget and with unequaled precision.

At TEQ, we want to exceed customer expectations in everything we do by:

- Leading in innovation
- Producing the highest quality products
- Distributing and manufacturing regionally
- Centralizing development
- Achieving an international reach

We are a total solution provider through our multi-national locations, strategic alliances, and talented staff. We've gone to great lengths to make sure we can provide every customer with exactly what they need. And creating multi-national manufacturing locations was just another way to better our reach and industry expertise to better serve our customer.

Chapter 1: Defining Moments

According to Ed Thompson, vice president and renowned analyst at Gartner, defining moments are "points in time when the essential nature of a person, group, organization or industry emerges." They are rare, meaningful moments that have significant consequences. If you are lucky, you have experienced a defining moment or two, from a life-changing personal event such as the birth of your first child to a moment in your career that alters the path of your business life to a major change at your company. At TEQ, we have not only experienced some defining moments but two of our most important moments actually happened over the past three years.

In November of 2015, we took the pivotal step of acquiring Fremont Plastics, a mid-sized custom-thermoforming company that specialized in sterile-ready and non-sterile medical goods, medical trays, medical packaging, and medical light handle covers. This allowed us to add to the medical thermoform products we already manufacture, such as the disposable probe covers for world-leading Braun infrared ear thermometer and paved the pathway for becoming a top tier medical device manufacturer.

Just a few months later, in February of 2016, we acquired the thermoform plastic and pulp packaging company Plastique, a $35-million-per-year plastic sheet thermoformer, with manufacturing locations in Nottingham, England and Poznan, Poland. This addition was critical in allowing us to offer our customers multi-national manufacturing capabilities, a wider range of sustainable packaging, and the ability support global and European-based medical device and pharmaceutical companies at levels never-before possible.

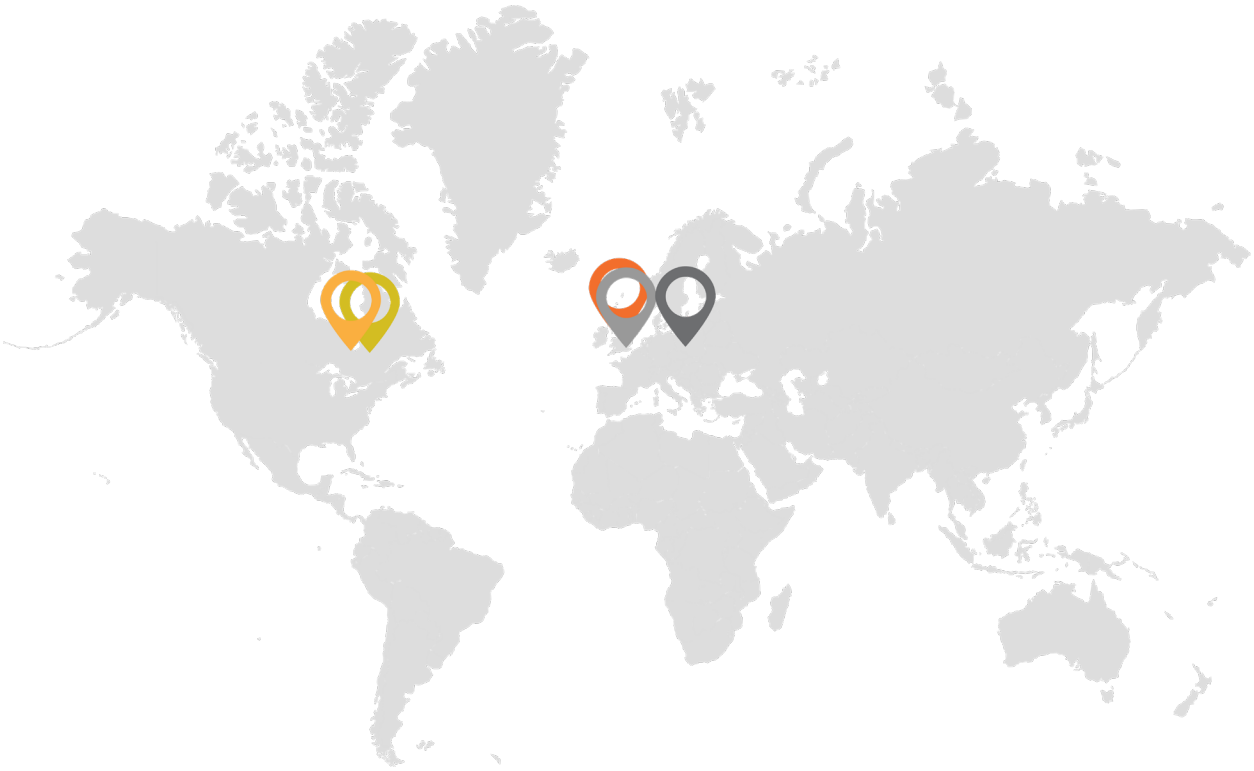
"We have multiple customers in the United States who prefer we have manufacturing closer to Europe," said TEQ President Randy Loga in a telephone interview. "The deal also helps Plastique Group supply its customer base with operations in the United States," he added.

Plastique's primary markets for packaging are pharmaceuticals, personal care, and specialties and mesh well with our diverse customer base. Most of TEQ's sales are packaging for food, medical, pharmaceutical, and personal care, but it also has a sizable industrial thermoforming business.

In total, we now have more than 30 thermoforming lines, 17 of which are in the United States. Our facilities operate Class 100,000 and 10,000 clean rooms, the newest cleanroom being an ISO 13485:2016 registered cleanroom in Plastique's Nottingham manufacturing facility.

We also wanted to note the addition of pulp molding allows the company to offer a wider

range of sustainable packaging. Customers can choose between thermoformed plastic and molded pulp, or a hybrid of both. Plastique Group can make high quality, precise packaging that is a step above most molded pulp packaging.



We have been growing organically in addition to the recent acquisitions. In 2013, we spent $6 million on upgrades and infrastructure in Huntley, including a second clean room and an ecologically beneficial elastomeric roof that saves it 15 percent in cooling costs. And by spring 2019, we should be completing a 48,00 square feet addition on the back of the Huntley building.

Our parent company, ESCO, has other operations making engineering filtration products for aviation, space and process markets. It also has a major presence in radio-frequency shielding products, provides diagnostic instruments and owns a library of machinery test results that are useful to energy generation and similar industries around the world. Its annual sales exceed $540 million.

“With the addition of Fremont Plastics and Plastique, both acquired at reasonable prices, we now have a technical packaging solutions business approaching $100 million in annual revenues with above industry average profit margins,” said ESCO Chairman and CEO Vic Richey in a news release. “We now have a solid foothold in Europe and have added a new complementary, technical packaging segment.”

With all of these additions, acquisitions, and positive changes, we’re excited to see where to journey takes us and what the future holds.

Chapter 2: Efficient machines and lower costs

If you are like many people, you may have received some sort of fitness tracker over the holidays or for a birthday. You are likely off to a good start on learning how this product can help you stay motivated and improve your health by tracking your activity, exercise, food, weight and sleep. But are you using it to its full potential? Taking steps (no pun intended) such as measuring your walking and running stride length, connecting to apps like My Fitness Pal, customizing the display, and setting up challenges between friends can make this motivating experience even better. But learning which modifications and supplements work best for you to get the most of your tracker will take time and experience. Interestingly, the same could be said of manufacturing equipment.

Take for instance, the Kiefel Speedformer.

While other thermoform manufacturers may have a limited number of these machines, at TEQ, we made the decision much earlier than others to adopt this high-end machinery. This decision allowed us to gain years of experience and develop the level of skill needed to elicit the faster processing speeds, superior quality and exceptional process control that these impressive machines are capable of.

In addition to our early adoption, we also boast one of the largest installations of Kiefel machines in North America, including two new machines – a Kiefel KMD 78 at our product development and manufacturing headquarters in Huntley, IL and a Kiefel KMD 90 at our new medical device facility in Fremont, IN.

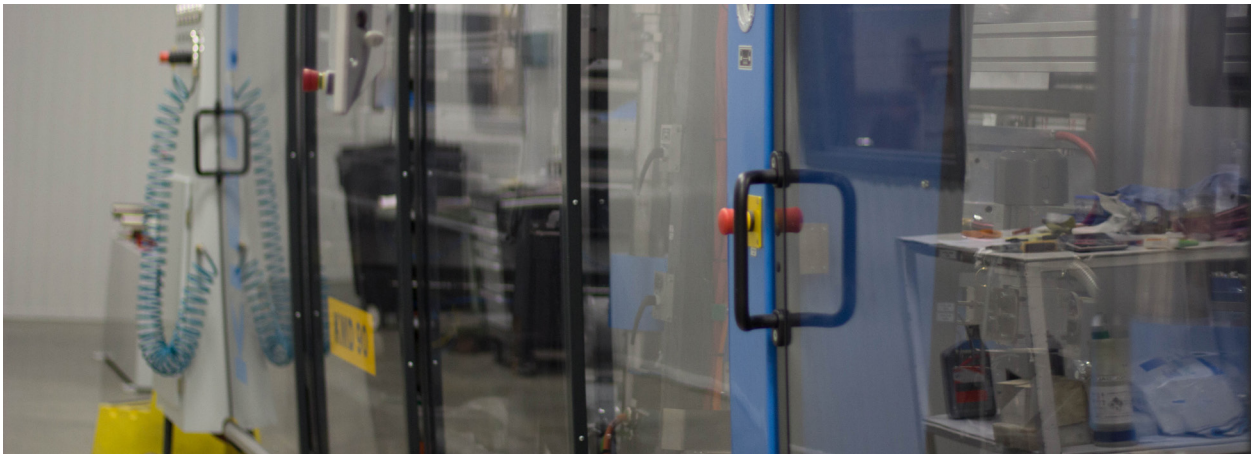
The KMD 78 combines simple operation with maximum efficiency and a wide range of capabilities and includes:

- A heating station with efficient black ceramic elements (HTS) and individual element control
- A pyrometer to measure and ensure stable film temperature
- A forming station to include cut-in-place capability
- A stacking station that is configured as a pick & place allowing for flexibility of handling difficult part geometry

While Kiefel's Speedformer KMD 90 offers fast cycle times, large forming areas and reduced energy consumption, and can also process a wide range of materials. Features of the KMD 90 include:

- The largest forming area of the Speedformer series (35"x37" max. tool size)
- High-output black ceramic heaters to ensure high efficiency
- A film edge heater to handle both brittle or thick material
- A servo-driven forming station with a servo third-motion plug drive
- 44 tons of clamping pressure
- Centric servomotor-actuated knee lever drives with high stability and smoothness
- Fast and ergonomic operation maintained by the separate tool change station

These two new machines not only help expand our installation to include our newest locations, but with our in-house expertise and years of experience, we are poised to offer our customers a high degree of quality, automation and efficiency combined with lower production costs and energy consumption.



Kiefel's machines have great features that are a huge benefit to medical device manufacturers because these machine work so well in clean rooms. A cervo powered machine, as opposed to a hydraulic powered machine, helps keeps down particulate on the part being manufactured and also aids in the validation process.

Chapter 3: Equivalent vs. Identical

Imagine you've just come from the doctor where you've found out you need a kidney transplant. You have a few options, wait on a national list, or attempt a transplant from a sibling or your identical twin. Success rates from identical twin donors reach almost 90%, whereas rates from siblings are closer to 60%. So, the choice to attempt a transplant from your identical twin is a no-brainer for success. Identical versus equivalent matches can make or break the success of a transplant. The same line of thinking applies to medical device packaging.

When creating additional multi-national manufacturing locations, the operations of those new facilities need to be identical to all other operations, not equivalent, to keep the same high integrity of the packaging.

For instance, when we first worked with our customer who provides safety medical devices, we worked very closely with our machine operators in Huntley, IL to design a new automation process. This new process put an end to rejections for quality, time delays, and machine shutdowns caused by the difficult dimensions (very deep slots) of the 19-cavity tray–without affecting price point – earning us a Supplier of the Year award.

Fast forward five years. This company was acquired by a global medical technology company, and that meant they needed to move the manufacturing and packaging overseas. Given the "tribal knowledge" we had developed over the years, it would have been very difficult for our customer to start over with a new thermoform manufacturer. Lucky for them, we had just acquired a company that gave us multi-national manufacturing capabilities that were nearby our customer's new product manufacturing facilities.

However, the most important factor for this transition to be successful was our ability to ensure that our facility had identical tooling and equipment, creating redundant clean room manufacturing cells on a multi-national level. And once we were able to prove and validate the identical tooling, our customer was able to move their manufacturing and packaging overseas.

Chapter 4: Expanding Cleanroom capabilities

TEQ has completed an ISO class 7 cleanroom at their Nottingham, UK facility in 2017. With manufacturing facilities in Huntley, IL and Fremont, IN certified to ISO 9001 and ISO 11607 and the Nottingham, UK and Poznan Poland facilities certified to ISO 9001, ISO 14001, and BRC/IOP, we now have the ability to produce thermoformed products and packaging for a wide variety of industries including cosmetics, personal care, pharmaceutical, medical, food/beverage, electronics, component handling, and retail.

In order to expand our reach into the medical and pharmaceutical arena in Europe, this cleanroom was a must for TEQ. Now, we have the ability to bring our precision made, custom thermoforming expertise to the European market. The cleanroom facility is certified to ISO 13484: 2016 and manufactures custom thermoformed handling trays suitable for high-speed production with automated assemble and transit. Some of TEQ's handling tray solutions include auto-injectors, dry powder inhalers, injection molded components, pre-filled syringes, pharmaceutical bottles, and medical electronics. We can also manufacture a number of other medical packaging solutions including trays, procedure sets, clamshells, tubs, skim pack sets, covers, lids, sterile barrier systems, and seal blisters.

TEQ has also extended the manufacturing capacity for thermoforming and fiber molding in Poland. The fiber molding business, Fibrepak, is a process that uses the latest "Cure-in-the-Mold" technology to produce the highest quality, most well-defined fiber packaging available. Products differ from traditional registration to ensure a consistent fit. It also allows for thin walls to have precisely trimmed edges, for defined hinges, and smooth premium finish.

Chapter 5: Harmonizing between nations

Operating in multiple countries can present some challenges. For example, many countries have different regulations when it comes to ISO standards. So, when we heard about the new EU Medical Device regulations, we knew it was going to be important to understand the importance of the potential between ISO 11607 and the EU's Medical Device Regulations.

Now that we have multi-national manufacturing capabilities, there is potential need for our clean rooms to operate under the EU's Medical Device Regulations as well as the ISO 11607 Standard. And there has been a push to harmonize these two standards. Part of harmonizing these standards is the ability to prove aseptic presentation. Being able to aseptically present medical devices in a sterile environment is becoming more important than ever and is likely going to become part of the ISO standard.

With many ways to package a medical device, it may be hard to decide which route to take. But packaging a medical device with a thermoformed package can have the following advantages:

1. **Product Orientation:** A nurse may need to quickly confirm a product's orientation and how to grab it. With a thermoformed tray, a nurse can be sure that the medical device stays securely in place in the intended location so he/she can remove it swiftly and confidently.
2. **Handling Assurance:** To make ensure a device doesn't compromise sterility, a nurse needs to control the movement of a device as its package is opened. A thermoformed package is more likely to ensure there is no unnecessary rotation or accidental removal. In fact, in a Packaging Digest article, one nurse stated that "…'we don't like these,' referencing the header bag. 'There's not as much control.'"
3. **Clarity:** A nurse can find it beneficial to see and identify the product clearly so he/she can better present the device or see any potential defects.
4. **Consistent Opening Experience:** Incorporating a good peal area in the package design can allow a nurse an easy access point for pealing the lidding back from the package.
5. **Additional protection:** With rigid plastic, a medical device is protected in sensitive device areas. For example, a package can be designed so a syringe will not get depressed.
6. **More ergonomic**: A pouch can require both wrists to twist to open, putting repetitive strain on both of the nurse's wrists. With a sealed thermoformed tray, only one hand is opening the seal while the other is holding the tray in place.

Chapter 6: An unusual combination

Some things just seem to go together... peanut butter and jelly, milk and cookies, bacon and eggs – while others don't (think bacon and chocolate, peanut butter and pickles or hot sauce and cauliflower), at least at first. But on closer inspection (or tasting in this case) it is clear that these combinations can actually be quite dynamic and delicious. While they might not be edible, here at TEQ, we have a few unusual but powerful combinations of our own.

Take, for instance, molded pulp packaging, thermoformed plastic, and flexible pouches. On their own, each of these offer unique and considerable benefits.

Molded pulp packaging products are a cost-effective packaging solution made from sustainable, natural-fiber raw materials resulting in a recyclable and compostable packaging option which is sturdy and strong and can be ovenable or freezer safe. Thermoformed plastic packaging solutions are extremely versatile, offering a wide variety of benefits such as durability, uniform sealing, and ease of sterilization; and flexible packaging solutions are low cost, light weight, environmentally friendly and highly customizable.

However, when it comes to manufacturing, these solutions are often only available via different vendors. When they are offered via one company, like they are here at TEQ, the combined benefits of true material neutral package design are even stronger – not bound by specific machinery or materials, we can provide the best material for our customers' packaging challenges.

Chapter 7: Improving supply chain sustainability

As the economy ramps back up, many companies are finding their supply chains as unwieldy as ever. With huge swings in supply and demand daily, supply chain flexibility and agility are becoming key concerns for businesses looking to grow.

So what factors are driving organizations to promote supply chain flexibility to the top of their agendas? Albert Sun and Glen Goldbach, directors at PricewaterhouseCoopers argue in their recent Industry Week article, How a Flexible Supply Chain Delivers Value, that:

- Emerging economies are causing a global shift in demand which includes material flow as well as finished products with a faster order-to-delivery time
- The complexity of supply chains is increasing related to cost, speed-to-delivery, and consumer experience
- Disruption and fragility of international supply chains caused by natural disaster, political unrest, and port strikes
- Companies are under increasing scrutiny from consumers and the media alike, which expect them to enforce fair labor conditions and sustainability practices

This focus on flexibility is precisely what we brought to the table when we took over Kaz's production of Braun Ear Thermometers. After auditing the existing workflow, we saw that the supply chain was wrought with inefficiencies subject to the restraints, delays and additional costs of overseas shipments and communication as well as the inability to transport finished goods cartridges.

We revolutionized their process by on-shoring their supply chain to keep the entire product lifecycle within the United States. This new process removed unnecessary delays and costs from the supply chain and allowed us to massively decrease the complexity of the supply chain. It also helped reduce the project's overall environmental impact by recycling and reusing secondary raw material.

And we're not the only ones adopting the idea of recycling and reusing secondary raw material. In her Plastics Today article, "Emerging markets look to recycle PET locally", Heather Caliendo illustrates that in many Eastern European countries, PET recycling projects are really starting to take off. While several industrializing nations were originally focused on growing their infrastructure and economy above other concerns (like the environment), countries

like Uzbekistan are starting to recognize the potential of secondary materials or products formally categorized as waste.

Rather than pitching roll cores and dumping polyethylene flakes, their manufacturing hubs are now working towards increasing efficiency and sustainability by recycling secondary raw materials rather than inputting new raw materials into the system. And when it's necessary to utilize primary raw materials, Uzbekistan is reducing imports to foster local production and "maintain and increase the growth of the national economy." With a focus on flexibility and localization, Uzbekistan is looking to drive modular manufacturing in the near future.

Similar to developing countries like Uzbekistan, we too are looking to decrease our environmental impact while also optimizing our manufacturing efforts – and do so by examining other supply chains like Kaz's to identify a variety of strategies to control costs, streamline work flows, and increase sustainability.

Chapter 8: Adapting to new times

Europe usually precedes the US in sustainability laws and regulations. It also seems like the US usually follows suit within 5 years or so of the new regulations being implemented in Europe.

So, when the UK launched a 25-year plan to eliminate all avoidable plastic waste, it definitely got our attention. With these new regulations already being implemented by companies, some saying they'll even eliminate avoidable plastic waste in three years, it will be important for the US to take note of the positives of the plan, the challenges the UK faces, and the solutions to those challenges as the next few years pass.

The UK has committed to eliminating all avoidable plastic waste by 2042. Under the pledge waste such as the carrier bags, food packaging and disposable plastic straws that litter the country and pollute the seas would be abolished. The broader 25-year plan, first promised three years ago, will also urge supermarkets to set up "plastic-free aisles" for goods with no packaging and confirm plans to extend the 5p (about 7 cents) charge for carrier bags to all English retailers.

It comes as the government seeks to improve its environmental credentials with recent pledges on animal protection and plastic microbeads.

The anti-plastic lobby in the UK gained significant momentum recently following broadcast of Sir David Attenborough's TV series Blue Planet II which drew attention to the harm done to creatures that become entangled in plastic or eat fragments that they have mistaken for real food.

With concern growing around plastic waste, British Prime Minister, Theresea May, has stated that, "We look back in horror at some of the damage done to our environment in the past and wonder how anyone could have thought that, for example, dumping toxic chemicals, untreated, into rivers was ever the right thing to do. In years to come, I think people will be shocked at how today we allow so much plastic to be produced needlessly. In the UK alone, the amount of single-use plastic wasted every year would fill 1,000 Royal Albert Halls."

In addition, the EU plans to make all plastic packaging across Europe recyclable or reusable by 2030. The pledge forms part of a wider plastic strategy to tackle the issue of plastic waste. Other commitments include a reduction in consumption of single-use plastics and restrictions on the use of microplastics, such as microbeads found in some cosmetics.

It is estimated that 8.3 billion tons of plastic have been produced since the 1950s, with research indicating that without urgent action to cut demand, this is likely to be 34 billion tons by 2050.

In the UK alone, during its recent Great British Beach Clean Up, the Marine Conservation Society found 718 pieces of litter for every 100 meter stretch of beach surveyed, and of this, rubbish from food and drink made up at least one fifth.

Dealing with plastics could have two parts: cleaning up what is already in the oceans (an estimated five trillion pieces of plastic) and stopping more from getting in. Marine scientists, however, say the overwhelming priority must be prevention: cutting quickly the flow of those eight million tons every year as much as half of it carried by rivers.
Although there is a role for removing plastics, from low-tech beach clean-ups to a high-tech proposal to extract the plastic floating in the Great Pacific Garbage Patch, the pollution is dispersed too widely across the oceans for a large proportion to be removed in this way.

The Ellen MacArthur Foundation, a leading anti-waste charity, estimates that international clean-ups could not deal with more than 0.5 % of plastics entering the seas. Yes, there are technological clean-up solutions, like big mechanical booms sweeping around in the middle of the ocean, but there is a danger of us being distracted from the priority of stopping plastics getting into the oceans.

That means changing both consumer behavior and product design — to discourage non-essential use of plastics, particularly for packaging, and making it far easier to recycle the plastics that are used. Plastics are not the enemy. They are wonderful materials. What matters is what we choose to do with them. It is not about doing without plastics but doing things differently.

Would the biggest gains not come from compelling manufacturers to design recyclability into their products, transforming the traditional linear economy (make, use, dispose) into a “circular economy”? Where packaging is essential, it should be simple and easily identifiable, so that recycling plants with automated sorting machinery do not face a perplexing plethora of different materials mixed or bonded together.

Chapter 9: Developing locally; producing globally

Think about the last time you went to your favorite restaurant. Does it matter to you to know where things you eat come from? For a lot of people, it does. And that's exactly what Alice Walker had in mind when she opened Chez Pannise in Berkley, California. She embraced the fact that people want to know where their food is being sourced from. And, according to an article written by Lorri Mealey in Small Business Online, "Today, restaurants are going beyond just buying fresh fruits and vegetables from local farms; now they are purchasing local beef, seafood, and even beer and wine."

TEQ applies that same philosophy to our business. We can not only provide the necessary information about the material we use, but TEQ has the ability to be "local" in a number of different places.

When it comes to developing a new project, it's important to work with a company with a similar industry background and who understands what landmarks need to be hit according the industry's quality standards. And at TEQ, our customers are always confident in knowing we have traceability to know exactly where the material for the project came from, what the resin of the material is made out of, and the quality of the facility where the project being produced.

TEQ can also be a local source in more places than just the US. We pride ourselves in the ability to understand customer requests and work to develop their product or project locally with our three facilities in the Midwest. And the same can be said for our manufacturing locations in the UK and Poland as well. We will work diligently to make sure a customer's project is executed expertly and in the location that makes the most sense for them.

For example, a recent customer headquartered in New Jersey explained that they needed to have packaging produced and shipped in Europe. They thought they would work with our team in the UK to develop everything. But when they found out we have tool building capabilities in the US, they were ecstatic. They were able to work with sales people and designers in the US to start on developing the project before moving it over into Europe.

Because we have multi-national manufacturing capabilities, we believe are able to serve our customers better than other thermoforming companies. Here are four areas we think make the biggest difference in how we work with our customers.

1. **Currency** – It's important to be able to work with a company that can deal in multiple currencies. At TEQ, we have experience working in multiple currencies, so a customer can be rest assured we can handle the project, no matter what part of the world they are in.
2. **Time Zone** – Trying to schedule meetings and appointments can be difficult when you're in the same time zone as someone. But scheduling across time zones? It might sound impossible. But not for TEQ. We have offices in many different time zones around the world so connecting you with someone in your time zone won't be difficult at all.

3. **Language** – We all know a language barrier can be a difficult obstacle to overcome when trying to conduct business with someone. That's why TEQ will always fully prepared with our multi-lingual staff in order to better communicate your needs.
4. **Business Practice** – It's important to understand the business practices and regulations that a region of the world works under. But with multiple manufacturing locations around the world, TEQ is equipped with the knowledge of the region our manufacturing locations are in so our customers can be confident they're in the right hands.

With the ability to develop locally and produce globally, our customers can be confident they will get the same standard of production in the US, the UK or in Poland. Whether you're in New Jersey, London, or even Warsaw, Poland, TEQ is here to help you be successful multi-nationally.

For more information about TEQ's Multi-National Manufacturing Capabilities, contact:

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