The act of weighing materials is thousands of years old. Ancient civilizations used the weight of a product to determine its value to trade or sell it. Of course, weighing instruments have evolved dramatically – from basic balance scales to sophisticated automated machinery. However, the need to determine the value of the material by its weight always remains.

The world of weighing is vast, with devices including solids flowmeters, weighfeeders, PLC modules, load cells, belt scales, and continuous weighing integrators. Matt Morrissey, Product Manager for Weighing Technology at Siemens gives us a look at then and now – how products have changed, markets have expanded, and the approval process has become more challenging.

First things first: Why weighing?

Every industry uses weighing in one way or another. Industrial uses include static weighing, where material does not move as it is weighed by load cells, and dynamic weighing, where material is weighed in motion either by belt scale, weighfeeder, or solids flowmeter. A few examples:

- In the mining, aggregates, and cement industry: belt scales are used for custody transfer as material is sold by weight; weighfeeders control the flow of raw material for recipe blending; belt scales monitor the amount of material being added to stockpiles
- In the chemical industry: load cells support bins or hoppers to indicate material level for filling and dosing
- In the food and beverage industry: solids flowmeters indicate the amount of material added to a mixture
- In the water/wastewater industry: weighfeeders control the rate of additives during water purification

Choosing your weighing system

There are many different weighing solu-
Complexity made simple: trends in weighing technology

Tions based on the application need. Belt scales are the easiest solution to find—anywhere there is a conveyor belt transporting material, there could be a belt scale. If you have moving material and need to know its rate or speed on the conveyor, a belt scale is your answer.

Weighfeeders are a bit more complex than a belt scale in that they also control the flow of the material. A weighfeeder is a complete weighing solution that has been designed for weighing accuracy and repeatability. Typically weighfeeders are used to introduce materials into a process out of a bin or hopper.

Solids flowmeters can be more of a challenge to apply. They are used where material falls from one process to another by gravity. The key here is falling material, as solids flowmeters are placed in pipe and duct systems to indicate flow rates and totalize material flow.

Check weighers monitor the weight of a product to ensure it meets quality or production standards. Platform scales are used for inventory control. Dosing and batching machines ensure that materials are mixed at the right proportions to make food as delicious as possible. These are most of the weighing technology you will find in today's automation plants worldwide. But how did some of these technologies evolve? And what are a few real-world applications?

That was then...

Forty years ago when Siemens Milltronics started selling belt scales, the demand came largely from North America. This market had long-established industries well suited for belt scale applications. Conveyors were built to Conveyor Equipment Manufacturers Association (CEMA) standards and our goal was clear: target the mining, aggregate, and cement business, otherwise known as the "heavy" industries. We had one product and a clear understanding of how to interface with existing conveyors.

There is an old saying that the customer is always right. But we have also found that the customer is always different, too! Very few applications are the same from one to the next. This realization revealed a trend that has affected the way we develop and apply products.

And of course, over time we began to look at all those other industries like food and beverage, chemical, water/wastewater, and more. Those industries brought new lists of requirements, which were difficult to meet with products focused on "heavy" industries. From our single belt scale offering all those years ago, Siemens now has eight different versions of belt scales to meet applications: from food-grade wash down to 12,000 tph (13,220 stph) flow rates to hazardous environments. We have a complete weighing portfolio of products to serve industries that we had never focused on before.

Solids flowmeters

The first solids flowmeter from Siemens Milltronics (at that time, just called Milltronics) was introduced in 1970. Simply put, solids flowmeters monitor the rate of bulk material flow in a process. They continuously measure the impact force of the material under gravity feed conditions, and convert this signal into a flow rate used to control the material into a process or blending operation [Figure 1].

Over the years, solids flowmeter portfolio options have expanded: different products for different applications, different materials of construction for material compatibility, ASME and DIN flanges. All of this adds up to more options, more info, and more solids flowmeter applications.

Typical applications might be:
- Cement
- Mineral
- Plastics
- Food processing

From "heavy" industrial applications like monitoring the flow of aggregates on a belt scale (left) to weighing pumpkin seeds and controlling their feed rate (middle and right) in the food and beverage industry, Siemens continually expands its portfolio of weighing technology to meet the needs of customers.
We have a complete weighing portfolio of products to serve industries that we had never focused on before.

With the introduction of new flowmeter models, these traditional applications have expanded, such as the following in a cement finish mill:

The design of a finish mill most commonly consists of a very large diameter steel tube filled with a designated quantity of steel grinding balls. As the mill is rotated at an optimum rpm (revolutions per minute), the grinding balls crush the clinker/gypsum mixture into a fine powder [Figure 2]. For peak efficiency, the mill should run with an optimum load. Acoustic sensors such as Siemens Sitrans AS100 may be used to measure the frequency of noise coming from the mill, as there is a relationship between the frequency and amplitude of the sound generated and the loading of the mill. This reading must be instantaneous and not disrupt the material flow.

Load cell systems can weigh the entire mass of the mill and provide loading readings by weight. It is also important to measure the rate of materials being fed into the mill, which is usually done with a belt scale monitoring feed rates, but there is also a need to measure the rate of flow of the coarse rejects being returned to the mill from the separator system. This reading from the recirculating load, or regrind circuit, must be instantaneous and not disrupt the material flow.

The Sitrans WF250 is specifically designed for use with gravity air slide conveyors. The unique infeed section separates the flow of material and air so that the airflow is not totalized as material impact on the sensing plate. Siemens solids flowmeters only detect horizontal movement from the material impact. This ensures that material buildup on the sensing plate has no negative effect on accuracy. With these flowmeters, plant operators receive precise rate-of-flow measurements instantly without having to interrupt the flow of material.

Weighfeeders

When Siemens Milltronics first introduced its weighfeeder in 1980, the product line was based entirely on an “engineered to order” concept. Whatever was needed for the application would be built to suit. There was no catalogue sheet, no pricing structure, no outline drawings – and it took many phone calls and visits to ensure that end users received what they needed.

An engineered to order weighfeeder is designed for a specific application; it provides exactly what the customer needs and has asked for. Length, width, height, components, approvals, and color are all up to the customer. As you can imagine, designing and creating these individual-
Complexity made simple: trends in weighing technology

ized solutions is very time consuming and labor intensive.

Forty years later and the world is smaller than ever – information is available at the press of a button. Every manufacturer has a website that can be accessed anywhere in the world, allowing customers to view complete catalogue offerings and the many styles of weighing products. Siemens Sitrans WW200 weighfeeder alone features 1,440,270,720 individual configurations! From the catalogue, customers can access part numbers and prices with the click of their mouse—a far cry from having to visit a customer with a tape measure and sending a hand-drawn sketch for approval!

The world has gotten smaller, but customers’ requirements have not. Application knowledge and challenges are shared in blogs and during webinars (web-based seminars). One such shared weighfeeder application in the food and beverage industry is from Sloten, which produces milk powder for calves and young animals. Raw materials are processed into semi-finished products using a computer-controlled process that involves mixing of raw materials in liquid form, pasteurization, homogenization and spray-drying. After this process the semi-finished goods are transported to the Deventer, Netherlands manufacturing unit where they are processed into the end products.

Sloten wanted to increase production capacity and have the ability to make smaller batches. Traditionally the company makes large batches up to 300 tons, but there is a growing demand for smaller quantities. Sloten therefore defined a need for a new blending and batching system with a higher accuracy. The weighfeeders are the core of the production plant in Deventer, so downtime while replacing the system needed to be as short as possible to reduce productivity losses. Siemens offered an integrated solution with 14 high-accuracy Sitrans WW200 Series SD (sanitary duty) weighfeeders integrated into Simatic PCS 7 [Figure 3]. Sloten now has a freely programmable weighing and proportioning system that it can adapt to changing operational requirements.

Weighing electronics

And as for weighing electronics? In 1985 a customer contacted Siemens with the request to have a Simatic S5 board that would support all crucial functions of a weighing application such as set point, coarse and fine feed, and tolerance check. From that request, we initiated a development project, and in 1986 Siemens launched the first PLC-based weighing board.

Previous to this, customers were using standalone equipment such as the Milltronics Compuscale weighing integrator. For customers who don’t want their instruments connected through a PLC, integrators are still ideal—the current Milltronics BW500 offers the latest in weighing functionality and industrial communications. Since the 1980s, the Siwarex portfolio has introduced new modules and functionality to match the ever-growing PLC world.

One example of Siwarex FTC at work in the petrochemical industry comes from the Czech Republic. A company that produces raw materials for refineries, petrochemicals, and agrochemicals has five granulating plants, which were previously controlled with the Simatic S5 system using relays and PLCs from other providers. With the modernization of the entire control system, the aim was to improve the reliability of the plant and increase the system’s ease of use.

To better control the dosing process, the company installed Siwarex FTC electronic weighing systems for differential dosing [Figure 4]. During production, weighing sensors continuously weigh the entire mixing vessel, together with the product. As product is constantly flowing out,
the weight decreases continually. The loss in weight is recorded over a certain period and the material flow is calculated on the basis of the data obtained. The highly precise dosing and corresponding increase in product quality proved to be a significant advantage for the customer.

A world of approvals

With all of these products, one trend that has become challenging to manage is the local requirement for hazardous approvals and metrological certification. To launch a global product that meets each of these different approvals requires quite a bit of work, as there are multiple approvals and different ways to meet each approval. In response to this challenge, Siemens has developed different products and a variety of options to meet these varying requirements.

Every country has its own regulations and requirements, which are often quite different. For example, in Europe the method for protecting encapsulation requires almost double the thickness of North America. As well, in Europe, a belt scale can be approved at 0.5%, while the US offers 0.25%.

Each weighing product is typically approved for use in a number of countries worldwide, each certified by local authorities:

- Measurement Canada and Canadian Standards Association (CSA) in Canada
- National Type Evaluation Program (NTEP) and FM in the United States
- Measuring Instruments Directive (MID) and Atex in Europe
- Chinese Measurement Certification (CMC) and National Supervision and Inspection Center for Explosion (NEPSI) in China
- Gosudarstvenny Standart, meaning “state standard,” (GOST) and GOST Ex in Russia

Siemens offers many of these approvals along with over 75 individual products and millions of configurations to meet the ever-growing demand of our customers.

Even decades later, we know it is not simply about having the right product, but the right solution with the global support to ensure material is weighed accurately all the time.