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Technical Article

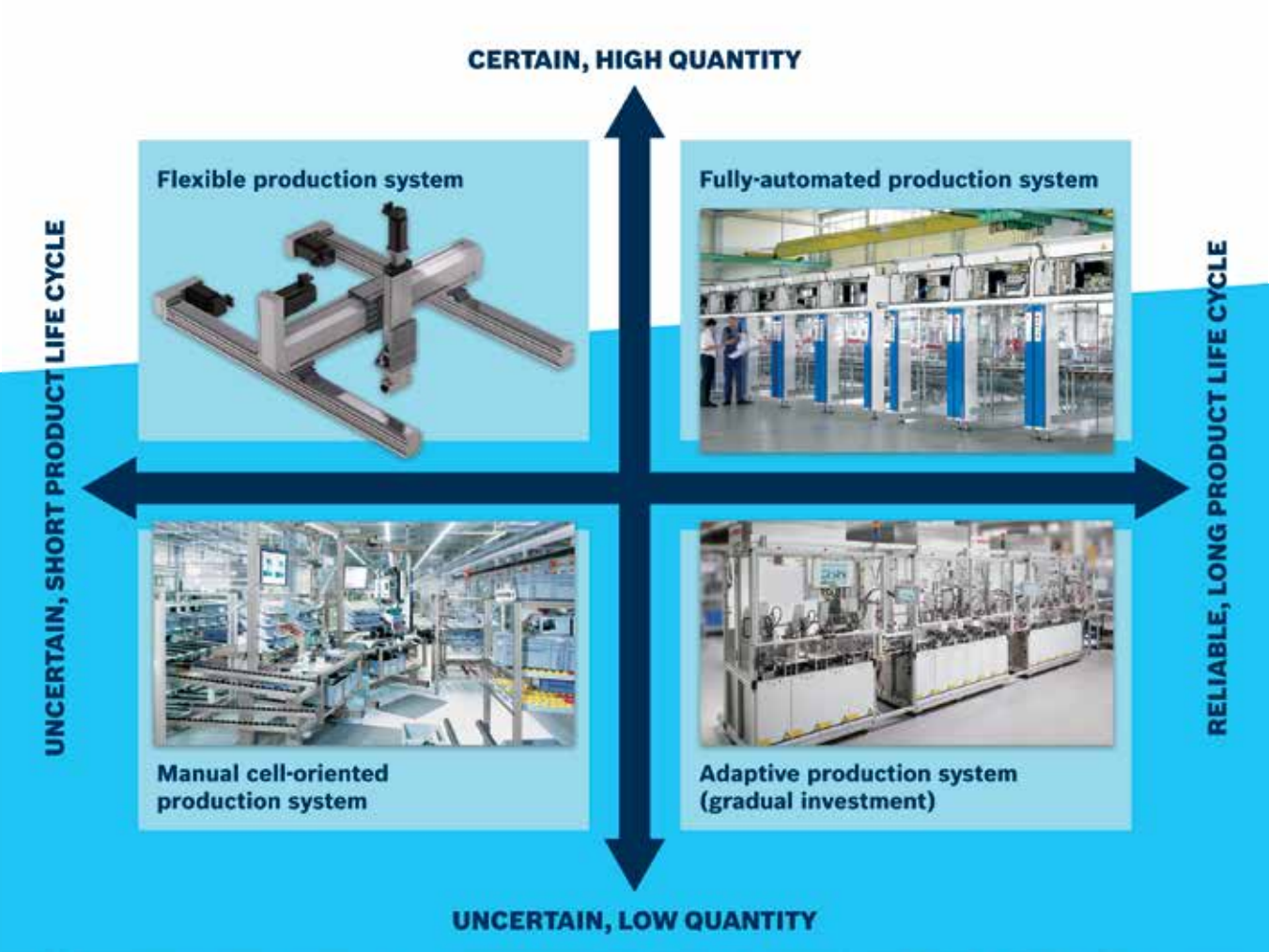
Using a conveyor system that incorporates high levels of automation can demonstrate that you are committed to producing the best product possible.

How to Choose the Right Conveyor System for Your Assembly Operation

Whether the product being manufactured is a mobile phone or an aircraft seat, the assembly processes will likely require some combination of manual and automated transfer operations. A simple but effective way to determine if a transfer operation should be automated is to consider two factors: production volume and product life cycle. A product with low or uncertain production volume and a short life cycle is often better suited for a manual transfer operation. Conversely, a product with high, stable production volume and a long life cycle is a good candidate for an automated transfer solution.

Key Insights & Considerations

- **A simple way to determine if a transfer operation should be automated is to consider two factors: production volume and product life cycle.**
- **When the decision leads to automated transfer, consider what benefits you expect to realize by using conveyor-based transfer – for example, reduced costs, increased throughput, or a better working environment.**
- **Transfer application requirements can be broken down into two parts: product requirements and process requirements.**
- **Pallet-based conveyor systems are often the best choice for assembly operations, and their modular construction makes them scalable as requirements change.**
- **When determining the ROI for an automated transfer system, include ongoing factors, such as maintenance, as well as improved safety and lower changeover costs.**



This decision matrix can help you choose between manual and automated production technologies. First, assess your product in terms of production volume and product life cycle. Then, chart these factors against the four main types of production solutions: manual, adaptive, fully-automated, and flexible.

When the expected volume and product life cycle make automated transfer attractive – or even necessary – for an assembly operation, the work of choosing the right conveyor system begins. But before you start exploring conveying options and specifications, the first thing you should do is answer the following question:

In some cases, automated transfer is implemented because the costs of manual transfer – including scrap or rework – are too high or too variable. Or, it may be that manual transfer operations simply can't keep up with increased volume or throughput levels. In other cases, automated transfer enables improvements in the working environment – in the form of fewer safety hazards, better access to materials, and improved ergonomics – which have been proven to increase productivity and quality.

"What benefits do we expect to see by using an automated, conveyor-based transfer system for this process?"

Application Requirements: Product versus Process

Once the expected benefits of implementing an automated conveyor system have been determined, it's time to begin defining the application requirements. Conveyor systems are inherently complex, and the task of choosing from among dozens of conveyor types and hundreds of configurations can seem daunting. But breaking the application down into two parts – product requirements and process requirements – can help simplify the analysis and guide you to the best-fit solution.

Product Requirements

Although it's common practice to start with the conveying process itself, it's important to define the product requirements first. In some cases, the physical features and nuances of the product (size, fragility, etc.) can be the determining factors when deciding which type of conveyor is best for an application.

Conveying Options for Assembly Operations

Automated conveyor systems can generally be categorized according to the type of conveying media they use: belt, flattop chain, roller chain, or powered rollers.

Belt media (flat or toothed) is ideal for transporting small parts and light payloads. Most belts feature an electrically conductive coating and are ESD-ready. Most belts are cleanroom-ready and are commonly used in "clean" applications, including medical device and electronics assembly.

Flattop chains are capable of supporting heavier payloads, and their side-flexing design makes them ideal for use with curves and for maintaining leading-edge pallet orientation. Flattop chain caps commonly overlap each other, which makes this media very "fastener-friendly."

Product Requirements	
Type	What type of product will the conveyor be handling? Different products and industries have unique handling requirements or challenges.
Size	How large, physically, is the product being conveyed?
Shape	Does the product have any oversized dimensions (extra tall, for example) or protrusions that might interfere with the conveying system?
Weight	How much does the product and any associated fixturing weigh? Will the weight change at any point during transport (i.e. as additional parts are assembled)?
Orientation	How should the product be oriented on the conveyor? For example, should one side face a particular direction in relation to the direction of movement?
Fragility	Is the product sensitive to shocks? Is it perishable?

Roller chains are available in many designs (steel, plastic, accelerating) and can be used in the most challenging environments. The power-and-free design creates a low-friction surface, allowing roller chains to convey heavy payloads. Most roller chains are also bi-directional, making them suitable for reversing applications.

Powered roller conveyors generally have the highest payload capacities and offer the most robust conveyance solutions. They're also very quiet in operation and have low maintenance requirements.

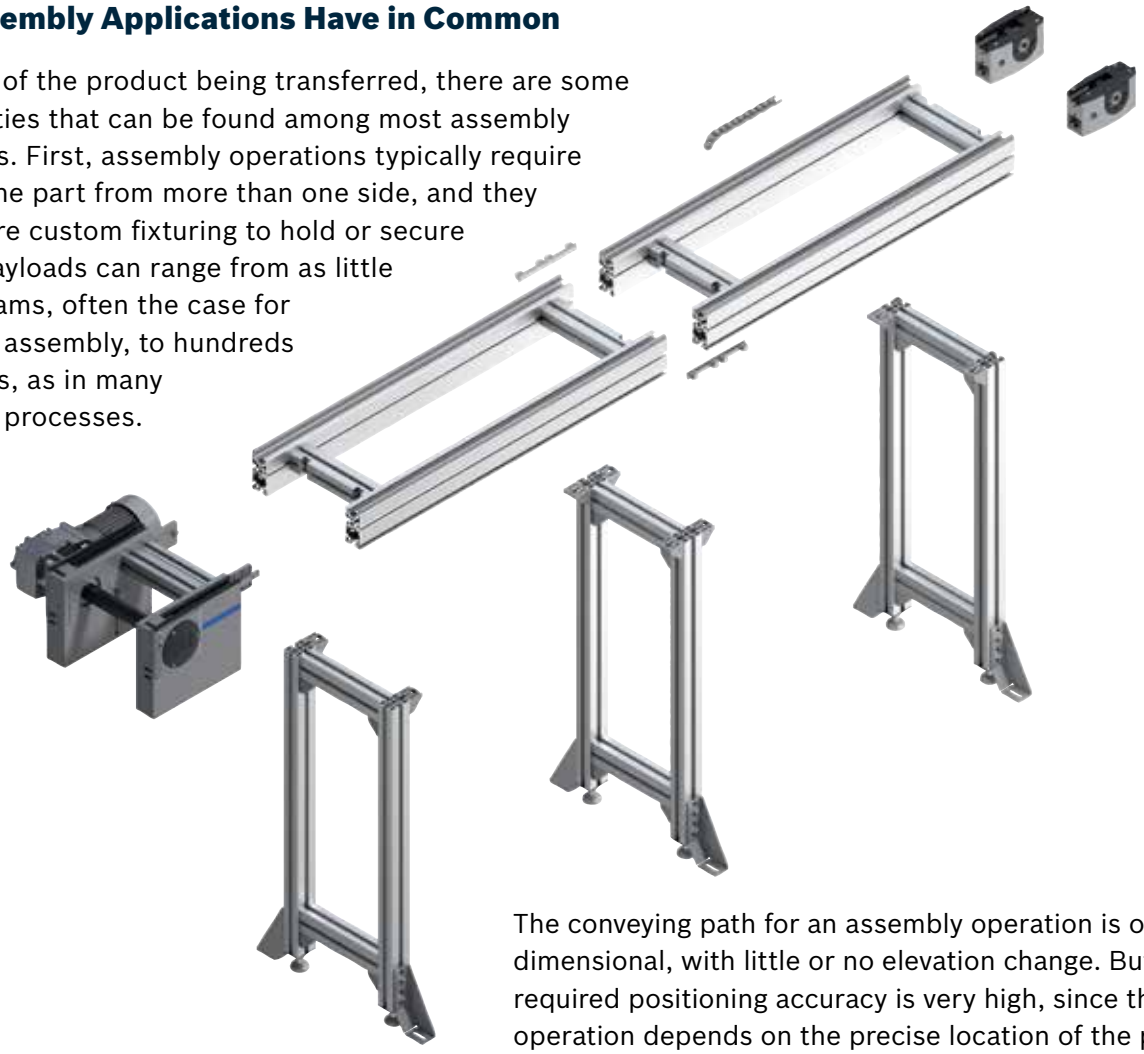
Process Requirements

Process requirements are those that determine how the conveyor will move, such as elevation changes or curves, and the environment in which it operates. Many of these requirements are dictated by the manufacturing facility and production goals.

Process Requirements	
Distance	How far will the product be moved? What is the distance between workstations or operations?
Path	Does the transport path require curves, elevation changes, stops, or diversions?
Speed	Does the transfer require slow and steady movements or short, rapid moves?
Positioning Accuracy	Does the operation require precise positioning? Or is the positioning tolerance relatively low?
Ambient Environment	Will the conveyor work in an extremely high- or low-temperature environment? Will there be dust, water, or other contamination in the environment? Does the conveyor need to be cleanroom, vacuum, or dryroom compliant?
Ergonomics	If personnel are working with product directly on the conveyor, what should its height be? What safety mechanisms are required?
Footprint	What floor space is available for the conveying system? Will it need to fit within an existing production layout?

What Assembly Applications Have in Common

Regardless of the product being transferred, there are some commonalities that can be found among most assembly applications. First, assembly operations typically require access to the part from more than one side, and they often require custom fixturing to hold or secure the part. Payloads can range from as little as a few grams, often the case for electronics assembly, to hundreds of kilograms, as in many automotive processes.



The conveying path for an assembly operation is often two-dimensional, with little or no elevation change. But the required positioning accuracy is very high, since the assembly operation depends on the precise location of the part.

Given these criteria, pallet-based conveyor systems are often the best solution for assembly applications. Pallet-based conveyors, such as Bosch Rexroth's TS Transfer Systems, are available in a range of sizes to accommodate the size, shape, and weight of the part being transferred. And they're available in belt-, chain-, and roller-driven designs to provide the required transfer speed and positioning accuracy. Pallet-based conveyors are ideal for two-dimensional transport paths with 90 and 180-degree curves, and they can accommodate small vertical transfer movements.

Another factor to consider when selecting an assembly conveyor is the scalability of the system. For example, if the product volume can potentially increase from 1,000 units per month to 10,000 units per month within a short timeframe, it will be simpler and more cost-effective to have a system that you can adapt to the new requirements – one that is scalable – rather than starting over with a new conveyor platform. Pallet-based conveyors are modular in construction, making them relatively easy to scale or reconfigure when production volumes or product requirements change.

Alternative Conveying Technologies for Extreme Transfer Requirements

When the conveying requirements include high-speed and high positioning accuracy, a relatively new type of conveyor system, based on linear motor technology, can fit the bill. Linear motor-driven pallet conveyors provide extremely fast transport with very good positioning accuracy. They can also be configured to meet stringent cleanroom or vacuum requirements and can operate with multiple, independently controlled pallets.

While linear motors are often regarded as specialized solutions for applications such as semiconductor and electronics manufacturing, they can also provide the perfect solution for much more common assembly operations.

In one case, a manufacturer of safety components for vehicles uses Bosch Rexroth's ActiveMover linear motor-driven conveyor system to move workpiece pallets independently of each other to precisely-defined positions. The conveyor is made up of straight sections and 180-degree curve modules, making a closed oval that totals 22 meters. Pallets can travel to each station independently, and sometimes travel to multiple positions within one station. And the system can work autonomously for 45 minutes before manual intervention is needed. With the capability to move pallets independently, speeds of up to 150 m/min, and accelerations of up to 40 m/s^2, the ActiveMover pallet conveyor system helped the customer significantly reduce cycle times.

Making the Case for an Automated Conveyor System

Once you've chosen the best conveyor system for your assembly application, the final step in the analysis is to weigh its benefits versus the other alternatives and demonstrate its return on investment (ROI). You defined the benefits by answering the question posed at the beginning of the analysis: "What benefits do we expect to see by using an automated, conveyor-based transfer system for this process?" Framing the answer in terms of the alternatives – i.e. manual or semi-manual transfer – is an easy task if the benefits have been clearly defined.

The return on investment, by definition, is an objective measure of the investment and quantifiable returns. It's important to remember that the investment includes not only the initial purchase price, but also the installation, operation, and maintenance costs. Likewise, the return includes additional sales and profit from increased throughput, in addition to reduced scrap and rework costs, reduced labor costs through better ergonomics and increased safety, and lower changeover costs when product or production requirements change.

And in some cases, the "hard," quantifiable ROI factors can be supplemented by "soft" ROI factors. One example is differentiation from the competition. Customers tend to view more favorably those manufacturers who embrace technology to improve quality and reduce costs. This is especially true when the product is complex or high-value. Using a world-class system that incorporates high levels of automation can demonstrate to customers that you are committed to producing the best product possible at the lowest cost.

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