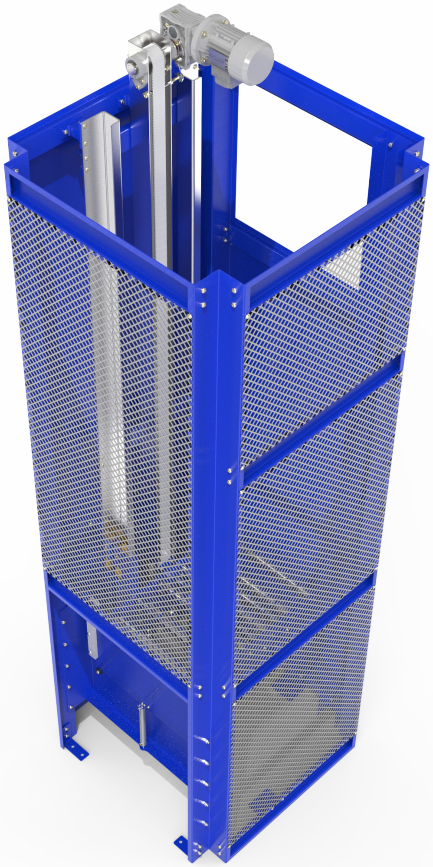
A Comparison of:
Vertical Transport Systems



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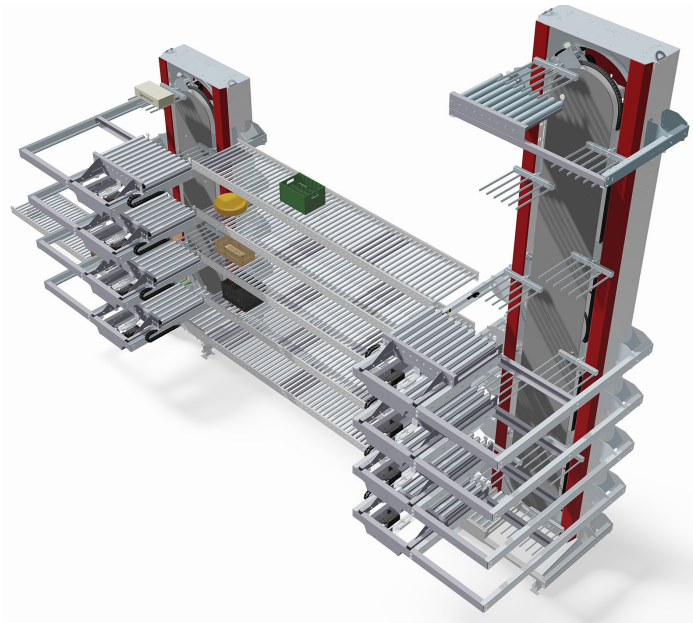
Contents - A comparison of vertical transport systems



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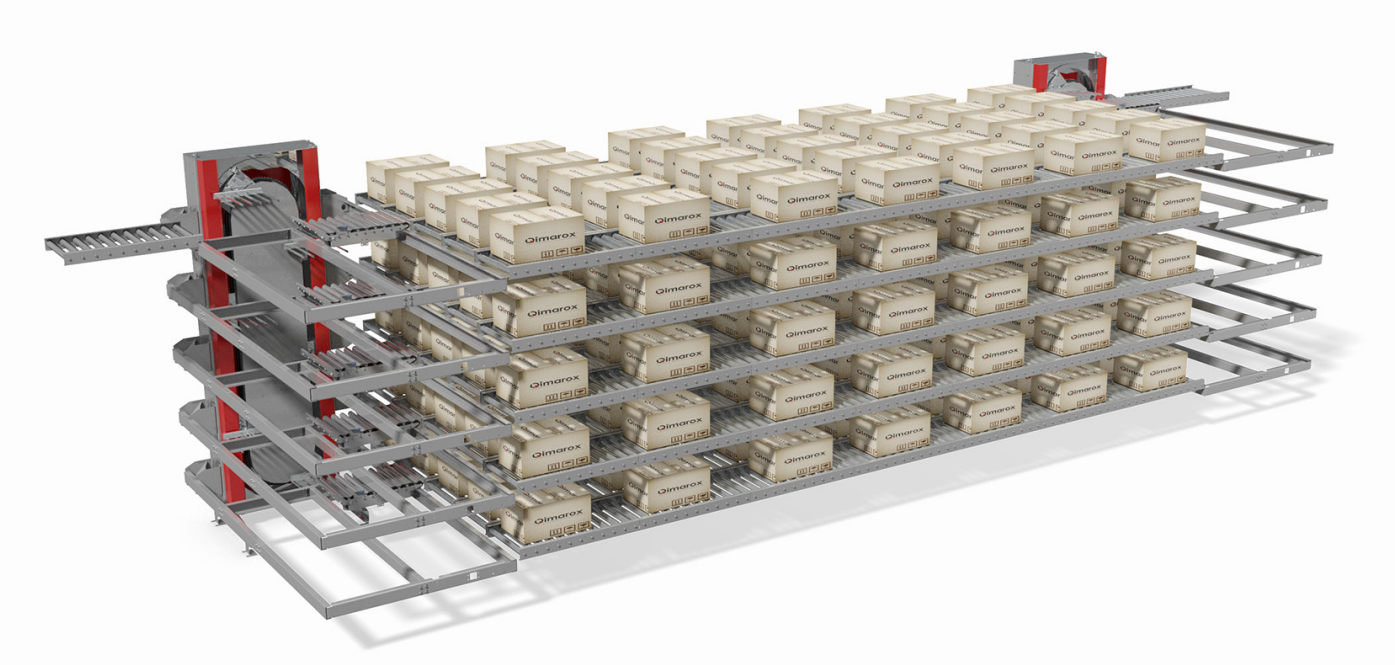
Why Vertical Transport?

Space is sparse and expensive. If possible, every square meter in a production area or warehouse should be used as efficiently as possible. This also means that products are increasingly in need of vertical space.

Given the layout of production processes, vertical transport is often necessary in a production line. One reason may be that products for the next machine in the line needs to be supplied at a different height. Sometimes it is simply desirable to free up the floor, for example to give people or trucks access or to make room for other machines. This will almost always involve a steady stream of mostly identical products that need to be transported no more than a few meters up or down.

In warehouses, it is important to not only use the number of square meters, but also the number of cubic meters as efficiently as possible. Activities such as order picking are increasingly conducted on different floors, which are connected through a transport system. This system must not only be able to transport products several feet up, but also back down again at a rate that varies considerably throughout the day. Additionally, distribution centers are making use of fully automated storage and order picking systems with all the characteristics of a production line.

Whether at a production line or in a warehouse, in both situations there is the need for an automated vertical transport system that can be fully integrated into a production line or logistics system. Selecting such a vertical conveyor is no simple task. There are many systems available on the market today which transports products up or down. Exactly how this is done however, varies greatly. This white paper will tell you more about the differences between vertical transport systems.



"Which vertical transport system is best suited in a company will depend entirely on the situation. After all, production and logistics processes are different in every company. The way products are supplied and removed again is one of the things that is important. At which speed and frequency are products supplied? Is the starting point and end-point of the vertical transport system always the same or are there - depending on the product(s) - different infeed and/or outfeed levels? Do the products need to be transported up or down or actually move in both directions? And, more importantlu, how much space do we actually have for the system?
Broadly speaking, there are five aspects that must be addressed in each selection process"

Five Aspects of Vertical Transport Systems

1. Use of Space

A vertical transport system is primarily intended to free up valuable floor space. Space which, as stated before, is scarce and is becoming increasingly expensive. It is therefore important that a vertical transport system not take up a large portion of this valuable space. And some vertical conveyors are simply more compact than others.

2. Infeed and Outfeed Directions

In the simplest situation the product will continue in the same direction after bridging a difference in height. However, there are situations where it is desirable for a product to be directed to a different or even opposite direction. Many vertical transport systems make it possible to combine change in outfeed direction with bridging differences in height. There are even systems where product orientation can be changed. This increases the number of logistics solutions and prevents the need to install a bend in the belt conveyor or roller conveyor immediately after the system. However, the number of possible infeed and outfeed directions varies per vertical transport system.

3. Infeed and Outfeed Heights

In some situations it is desirable to be able to pick up products from different heights and deposit them at various outfeed heights. This is frequently the case in warehouses, which often contain several mezzanines and where products must be circulated between all of these floors. Not all vertical transport systems can serve multiple infeed and/or outfeed heights.

4. Ascending and Descending

Especially in warehouses it may be necessary to alternate between ascending and descending products. Consider, for example, order picking across different floors. Products must not only be transported to the different floors but also be returned again at some point. A vertical transport system that can transport products both up and down eliminates the need for two different systems for these two movements.

5. Capacity

The capacity of a vertical conveyor depends in part on the speed. The faster a vertical transport system, the more products it can handle per hour. Another factor is the number of products that can be processed simultaneously. The minimum capacity required in any situation is almost always determined by the structure of the overall process. The vertical transport system should not be the bottleneck here. The vertical transport systems available on the market today can vary considerably in terms of the above aspects. Some vertical conveyors are simply faster, more compact and versatile than others. It goes without saying that the various systems come at different prices. The goal is to select the system that best fits your situation in terms of price and performance.

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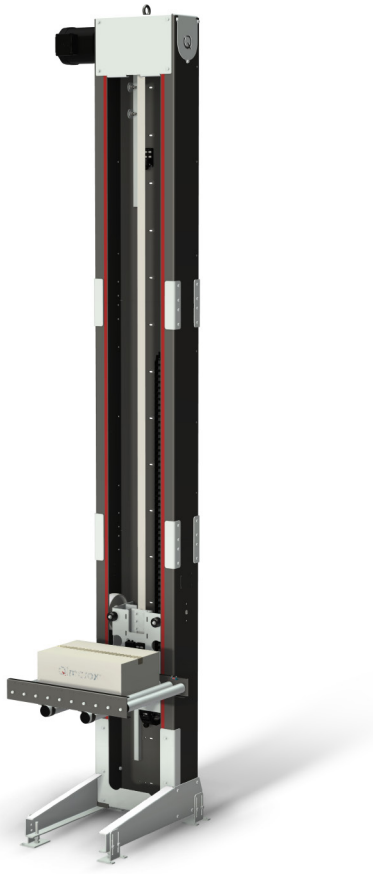
Five Types of Vertical Transport Systems

There are actually only two basic techniques for transporting products up or down. The first basic technique makes use of conveyor belts and the second of an an elevator system. Every vertical transport system on the market today makes use of one of these two basic techniques. If conveyor belts are used it is not necessary to integrate a start/stop function into the system. After all, products go straight from the feed belt to the conveyor belt, after which they are finally sent to the discharge belt. In an elevator system the rate of supply of products must always be controlled. Elevator systems do however travel the shortest vertical distance, meaning their use of space is minimal.

1. Inclined Belt Conveyor

The simplest way to transport products up or down is to use a normal conveyor belt that is placed under an angle. Capacity is generally not such a problem for inclined belt systems. After all, similar to on a normal belt conveyor, several products can be placed one after the other on an inclined belt conveyor. It should be noted however that a more powerful engine is needed to drive a inclined belt conveyor. The speed will often still be slower than with horizontal transport. In addition, outfeed and infeed direction are identical, unless a bend is fitted in the configuration as with horizontal transport systems. The main drawback of an inclined belt conveyor however is its use of space. This is entirely due to the slope of an inclined belt conveyor. In order to prevent products from falling over backwards or sliding down, the maximum slope angle – depending on shape, dimensions and weight – is usually somewhere between 15 and 30 degrees. This means that an inclined belt conveyor at a slope angle of 30 degrees must be no less than 6.0 meters long to bridge a height of 3.0 meters. With an angle of 15 degrees this increases to over 11.5 meters. Needless to say, the distance travelled and transport time for goods will increase too. It is however, one of the safest options.

2. Vertical Conveyor



The simplest is the so-called vertical conveyor: a single product carrier that continually moves up and down. The product carrier is suspended in a steel column and is usually hoisted using chains or hoisting belts. The only space that the Vertical conveyor occupies is the steel column that must be slightly larger than the maximum size of the products. The vertical conveyor has the advantage that one machine can serve multiple infeed and outfeed heights and transports products both up and down. A disadvantage of the vertical conveyor – sometimes called discontinuous product lift or start/stop lift – is its limited speed and capacity. The vertical conveyor can only transport another product after the last product has been deposited and the empty product carrier has returned to the starting position. The speed is thus determined not only by the upward but also by the downward movement. Another drawback is the restriction on the possible infeed and outfeed directions. The product carrier usually consists of a roller conveyor or a belt conveyor. Products can only be fed out in the same or exactly opposite direction as they are fed in. There is no other option.

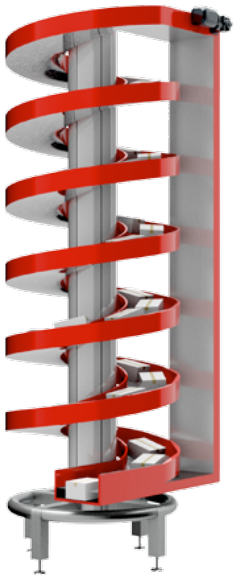
"Prorunner mk1: vertical conveyor with a mature design The Prorunner mk1 from Qimarox is a vertical conveyor that has been steadily developed in recent years. As a result, a product lift was created with a mature design where efficiency and effectiveness are paramount. This results not only in minimal use of materials and thus a low cost, but also in a long lifespan requiring only minimal maintenance. And of course the lift does what it was designed to do: transport products up and down, both quickly and easily. The Prorunner mk1 consists of a compact and sturdy steel frame that provides stability under all operating conditions. The product carrier is suspended from a hoisting belt, which, unlike a chaindriven system, does not require tension and lubrication. The hoisting belt is furthermore virtually silent. The design of the Prorunner mk1 is modular. This means that the product can easily be integrated into any production line. For example, the Prorunner mk1 comes fitted standard with a roller conveyor or a belt conveyor, but in principle any other product carrier can be built in without having to modify the construction."

3. Mat-top Conveyor

The main difference between a vertical conveyor and a mat-top conveyor is the direction of move-ment of the product carrier. With a vertical conveyor the product carrier goes up and down, whereas with a continuous product lift such as the mat-top conveyor the product carrier describes a loop. Once a product is transported to another level, the product carrier returns via a different route to the starting position. This makes it possible to install multiple product carriers and therefore transport multiple products per cycle. The capacity of a con-tinuous product lift is therefore much greater than that of a vertical conveyor. As the name suggests, he product carrier of the mat-top conveyor con-sists of a flexible, pliable mat. The mat is hoisted up using four chains or hoisting belts. Once the pro-duct reaches the right height and is deposited on a belt conveyor or roller conveyor, the mat makes its way back down via the underside. Most mat-top conveyors are really only suitable for situations with a fixed infeed and outfeed height. Combining ascending and descending movements in a single mat-top conveyor is difficult. Moreover, as with a vertical conveyor, the number of possible infeed and outfeed configurations is limited. Products can only be fed in or out in the same or opposite direction. An additional drawback is that not only the rate of supply of products needs to be controlled but the feed belt and lift must also be precisely synchronized. If the mat is a little too early or too late then the product will fall into the lift with all the associated problems. In the event of a default the chance of product damage or product contamination is already high, because the product is always located inside the lift while it is being transported up or down. The advantage of the mat-top conveyor is its limited use of space. Furthermore, the necessary shielding can also be integrated into the lift. It is also relatively easy to transport longer or heavier products. The process here is no different.

4. Spiral Conveyor

A spiral conveyor is nothing more than a belt conveyor that runs up or down in a spiral. The main advantage of a spiral conveyor is its capacity. As with an inclined belt conveyor, products can be fed continuously one after the other, keeping in mind that a certain gap must be observed between the products in connection with the ascent angle and the radius. It is possible to fill the entire spiral with products, so this solution is also suitable as a buffer system. Another advantage is the flexibility with regard to infeed and outfeed direction and infeed and outfeed height. In principle it is possible to feed products in and out at any angle and at any height, simply by connecting a horizontal belt conveyor or roller conveyor to the spiral conveyor at those points. It should be noted that due to the spiral shape it is not possible to freely select both infeed and outfeed directions and infeed and outfeed heights. Another disadvantage is the amount of space that a spiral conveyor occupies. Because the products follows a spiral with a certain radius the space occupied by a spiral conveyor is several times larger than that of a vertical conveyor or mat-top conveyor. The longer and wider the product, the greater the radius and space needed and the more expensive the spiral conveyor. The spiral movement also ensures that products must travel a relatively long distance, resulting in a long drive system that requires extra power (energy consumption) and maintenance. There are spiral conveyors on the market that can simultaneously transport products both up and down. Actually, these would be spiral conveyors with two belts: one on the inside and one on the outside. A disadvantage is that the products on the outer belt have to travel very long distances, making it often more convenient to install two spiral conveyors with one belt conveyor. Of course, a spiral conveyor with a double belt conveyor not only requires a double drive but also a larger diameter and thus more floor space.



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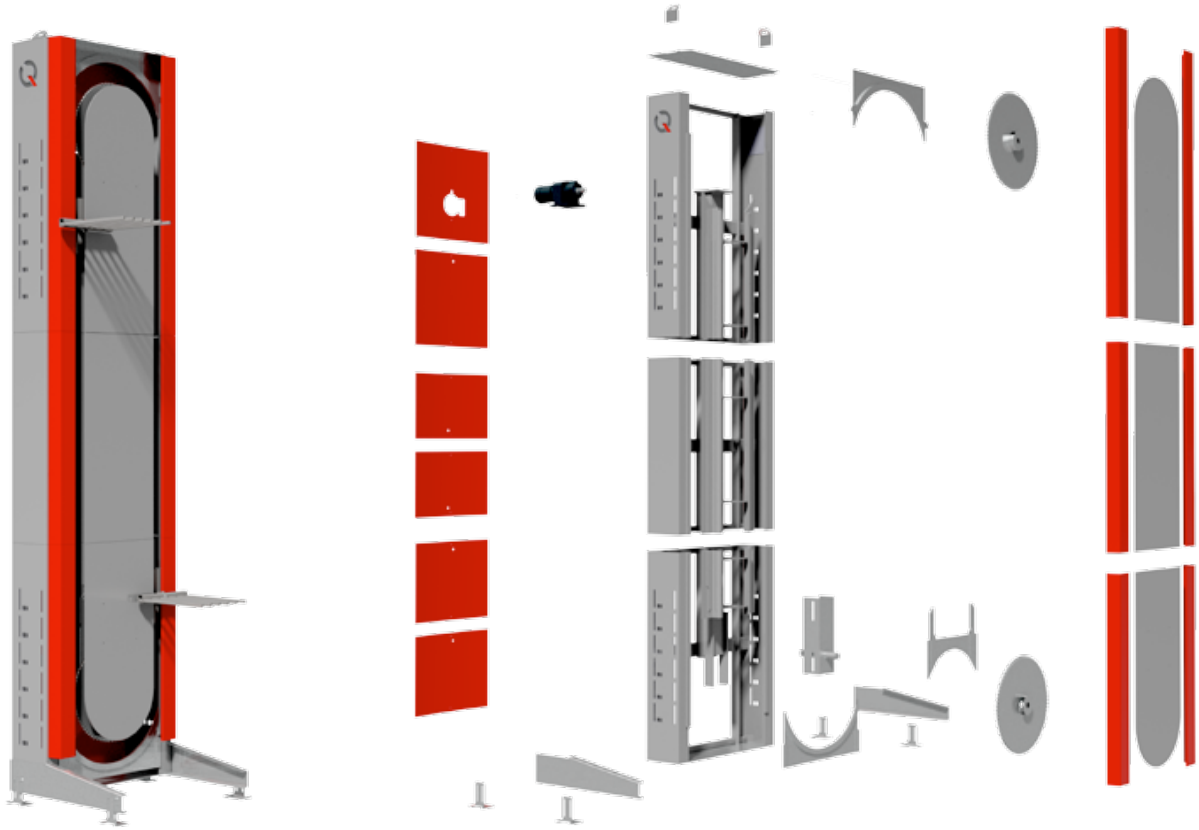
5. Paternoster Lift

The final version is the paternoster lift, a continuous product lift that also has multiple product carriers that travel in a loop like the mat-top conveyor. There is however one important difference: all product carriers remain horizontally positioned during the entire circuit, so that in principle a product can remain on the carrier for the duration of the cycle. This has the advantage that a paternoster lift can serve multiple infeed and outfeed heights. Moreover, the paternoster lift is the only vertical transport system which can lift and lower multiple products simultaneously. A paternoster lift does require a little more space than a vertical conveyor and a mat-top conveyor, but not nearly as much as an inclined belt conveyor or spiral conveyor. In terms of capacity, this system is similar to an mat-top conveyor. Specifically, this means that the paternoster lift has a much larger capacity than a vertical conveyor, but that it can't really compete with an inclined belt conveyor or spiral conveyor. It is possible to expand the capacity – to some degree – by adding more product carriers or placing multiple products on a carrier without having to increase the speed of the system. Similar to the mat-top conveyor, the paternoster lift also needs a supply rate controller. Accurate synchronization between the feed belt and lift is not necessary, thanks to the specific design of the product carriers. This makes a paternoster lift a lot easier to integrate than a mat-top conveyor in terms of control.

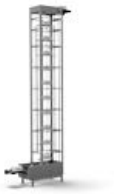
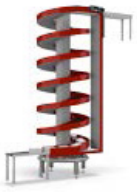


"Prorunner mk5: the unique paternoster product lift With the Prorunner mk5, Qimarox has reinvented the paternoster lift. The main feature of the Prorunner mk5 is the product carrier, which resemble forks. These product carriers are only attached to the drive system on one side. The patented system ensures that the product carriers remain in the horizontal position throughout the entire circuit. A product can therefore remain on the product carrier during the entire circuit. That the product carriers resemble forks offers an important advantage. It allows products to be picked up from and deposited on roller conveyors simply by moving the forks between the rollers. The result is a smooth infeed and outfeed of products without product damage. By alternately manoeuvring the infeed and outfeed conveyors in and out of the circuit of the product carriers, the Prorunner mk5 can be used in a setup with different infeed and outfeed heights. It is now possible to use one paternoster lift for both ascending and descending product flows. The fact that the product carriers are only attached to the drive system on one side offers an additional advantage over conventional continuous lifts. It enables the Prorunner mk5 to feed products in and out in three directions. This is because it is not only possible to feed in and out in directions that are in line with the circuit, but also in directions that transverse the circuit. In cases such as this, drive belts are used as roller conveyors, which function as infeed and outfeed conveyors."

Pros and cons

The following table provides an overview of the pros and cons of the various solutions. The paternoster is clearly a versatile vertical transport system that scores on several points such as speed and usage of space.




Type of vertical transport system	Vertical Conveyor	Paternoster lift	Platform lift	Spiral Conveyor	Inclined Belt Conveyor
Desired result					
Use of space	++	+	+	++	++
Infeed and outfeed directions	++	+/-	-	++	++
Multiple Infeed and outfeed Heights	++	+/-	-	++	++
Ascending and descending combined	++	+/-	-	++	++
Capacity	--	+	+	++	++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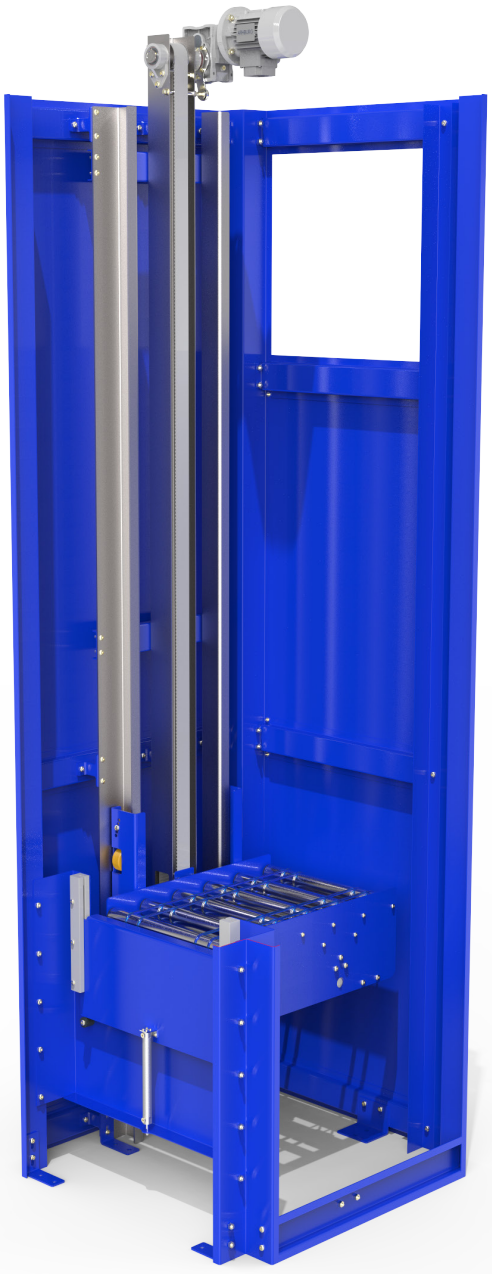
Cost of Vertical Transport Systems

The manner in which a vertical transport system can be integrated into a production line or logistics process is not the only important factor. Dyno Conveyors is New Zealand's most competent conveyor company. We consult for the most productive and cost effective system, and design and manufacture our own conveyors. We then integrate these with other machinery, such as lifters. We also install and do full automation to make the systems as productive and cost effective as possible, often by reducing labour costs. Other factors such as initial costs, installation, maintenance and energy consumption play an equally important role in choosing the right vertical transport system and the right supplier.



"Prorunner mk5: Available in XL size.

The Qimarox paternoster lift is available in two sizes. The standard version is suitable for products of 600 x 400 mm (24" x 16" inch). There is also an XL version that can handle products of 900 x 900 mm (35" x 35" inch). The Prorunner mk5 XL is especially interesting for logistics environments where transport boxes are often used that are larger than the maximum size that the standard version can handle. Despite its larger size, the Prorunner mk5 XL remains an extremely compact machine. The XL version is only 300 mm (11" inch) wider than the standard version. The maximum weight that a Prorunner mk5 can handle is 50 kg (110 lbs) per product carrier."

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1. Inital Costs

Many companies look first and foremost at the initial costs. These can vary considerably from system to system. In general, an inclined belt conveyor is the cheapest solution, followed – in ascending order – by a vertical conveyor, a paternoster, a mat-top conveyor and finally a spiral conveyor. One important factor is the height that must be bridged. The larger the difference in height, the greater the differences between for example a paternoster and a spiral conveyor. For each additional feet, not only the construction of the spiral conveyor but also the belt conveyor must be extended. You will probably need an additional or at least stronger engine with the appropriate frequency regulator to lift the additional feet of belt conveyor and products. In other words, a spiral conveyor that is twice as high is also about twice as expensive. With a lift this is different, whether it is a discontinuous product lift, continuous product lift or paternoster lift. In these systems, only the length of the steel construction and the length of the hoisting cables or chains needs to be extended. After all, the number of moving parts, product carriers and drive motors remains the same. A discontinuous product lift of 30 feet is therefore only slightly more expensive than a lift of 15 feet.

2. Integration Costs

Inclined belt conveyor and spiral conveyors are relatively easy to install. Of course, these vertical transport systems require a relatively large amount of space that needs to be made available beforehand, but once this has been done they can be installed without much additional effort next to any roller conveyor or belt conveyor. The products flow onto the inclined belt conveyor or spiral conveyor without stopping, on their way to another level. Both machines still require some control software. However, this is only needed for the engines, and with a spiral conveyor also for the chain slack protection which prevents problems caused by chains slackening. A lift requires a bit more work. Reason being, that the supply of products and movements of the product carrier must be geared to one another. After all, a product can only enter the lift once an empty product carrier has arrived. With a mat-top conveyor, unlike a paternoster lift, both movements actually need to be accurately synchronized. This requires a bit of control software, which is fed with data from sensors. For the programmers who already have to code the control system for an entire production line or transport system those few extra sensors won't really pose much of a problem.

3. Energy Costs

There are costs that extend beyond the commissioning of your vertical transport system. First, there is the cost of running the system, the energy costs. The advantage of vertical conveyors, mat-top conveyors and paternoster lifts is that with these machines the products always take the shortest route, i.e. straight up. With inclined belt conveyors and spiral conveyors the distance is multiplied, resulting in higher energy costs. The greater the differences in height, the greater the difference in energy consumption between elevator systems and spiral conveyors. An increasing amount of energy is required to lift the additional feet of belt conveyor including the products on them. In an elevator system the relationship between differences in height and energy costs is less strong. The paternoster lift is a real exception when it comes to energy costs. With a paternoster lift the ascending and descending carriers balance each other out. This effectively means that energy is only needed to transport the products up, not for the product carriers themselves. In most situations an engine with an output of 0.37 kW is therefore sufficient.

"That is less than half the power required to run a spiral conveyor. In situations where the elevator is kept running continuously 24/7, the difference in energy costs amounts to over US$1,000 per elevator per year."

4. Maintenance Costs

When it comes to maintenance costs, the differences are great. The solutions with belt conveyors (inclined belt conveyor, spiral conveyor) often have a very large total length. A belt conveyor is quick and simple to maintain, and Dyno has spare parts available at short notice. In most spiral conveyors the belt conveyor consists of a long chain covered with overlapping slats. Dirt and dust can fall from the products through the slats and directly into the drive system. In addition, products can be turned by the overlapping moving slats and end up getting caught between the side guides, which can cause extensive damage. A vertical conveyor is easy to maintain and has few critical points. With mat-top conveyors (depending on the manufacturer) the delicate drive system often consists of a very expensive rubber chain. Possible replacement of the chain can be very costly. And, should a product fall, could will result in dirt and damage in the drive system. Just like the vertical conveyor, the paternoster is easy to maintain. The drive system consists of an extra-strong standard steel chain that is cheap and readily available around the globe. The forks are product-specific, but very quickly interchangeable. Its control system protects it from jamming.

5. Total Cost of Ownership

Initial costs, integration costs, energy costs and maintenance costs: these are all part of the total cost of ownership (TCO) of a vertical transport system. The table below compares the cost of the five different systems. And yet it is not wise to look only at the total cost of ownership of a single system. It is more relevant to look at the TCO of the total production line or logistics system that was installed. No matter how good the vertical transport system is, if elsewhere in the overall system something is wrong the company still has a problem. Besides cost, reliability is also important. Irrespective of the price of the vertical transport system, if it stops working an entire production line will often stop working too, resulting in considerable expenses and perhaps even lost turnover.

Pros and cons

The following table provides an overview of the advantages and disadvantages of the various vertical solutions.

Type of vertical transport system	Vertical Conveyor	Paternoster lift	Platform lift	Spiral Conveyor	Inclined Belt Conveyor
Desired result					
Initial costs	+	+	+/-	-	+
Installation costs	approx.	approx.	approx.	++	+
Energy costs	approx.	++	approx.	--	-
Maintenance costs	+	+	--	-	approx.

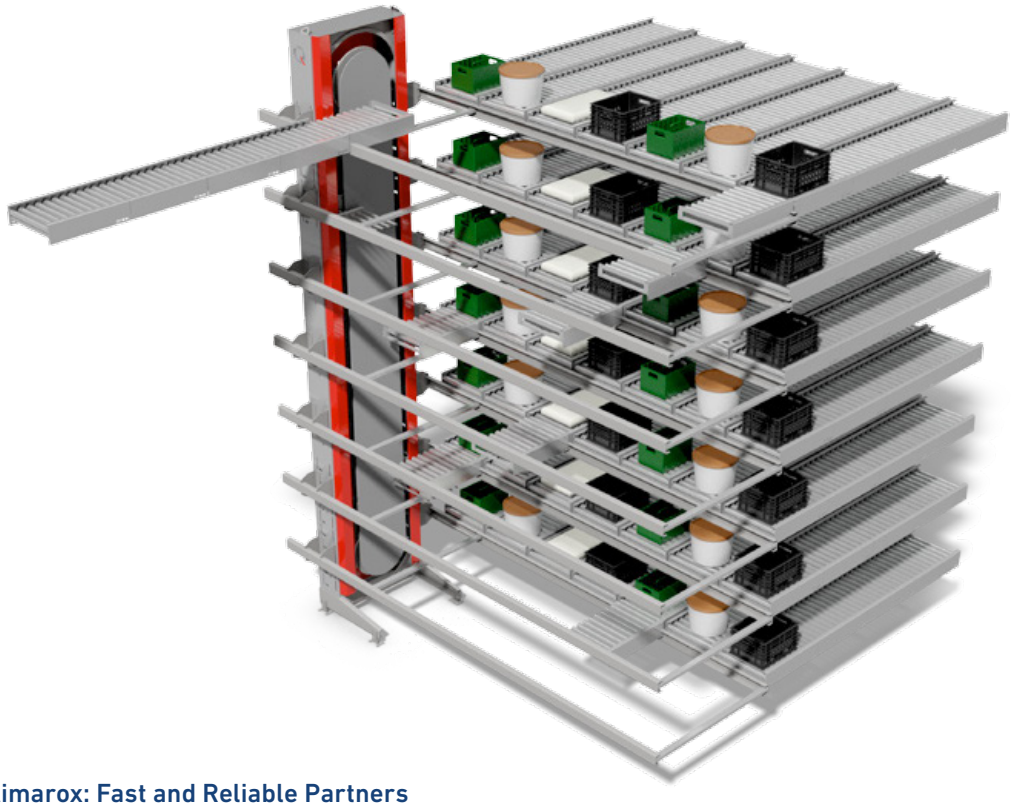
Optimal price / Performance Ratio

Choosing a vertical transport system is a process that involves many different solutions with both strengths and weaknesses. First, the system must fit perfectly in the layout of the production line or warehouse. A production line will generally involve a steady stream of identical products that need to be transported no more than a few feet up or down and often only in one direction. Capacity, reliability and maintenance-friendliness are important factors. Flow diagrams are much more complex. Products must not only be transported upwards but downwards as well, which will often involve multiple levels. The number of products that need to go up or down can change from minute to minute. A vertical transport system will thus soon become a vertical sorting system. Flexibility and versatility are important in such situations, where capacity should be large enough to avoid creating a bottleneck.

In a world where costs play no role, inclined belt conveyors or spiral conveyors would be the preferred method of transport if very high capacities are required. In the opposite case, if required capacity is low and complexity minimal, you would be better off with a vertical conveyor. In practice however, capacity is neither especially high nor low, but rather somewhere in between. And of course in the real world cost does play a role. Ultimately, choosing a vertical transport system is choosing the optimum price/performance ratio. In the comparison between the different systems the paternoster lift scores the highest on both price and performance. This concept – revived by Qimarox – really has no weaknesses. The paternoster is flexible when it comes to the number of infeed and outfeed directions and levels. This lift fits every operation. Above all, the paternoster lift also has undeniable advantages in terms of maintenance. No wonder the paternoster lift has gained so much market share in recent years compared to other vertical transport systems.

Vertical Sorting

The Prorunner mk5 is one of the few vertical transport systems that can also serve as a vertical sorting system. Especially in warehouses, due to the increased usage of different floors, there is an increasing demand for systems that allow product movement between the various levels. A concrete example is the use of the Prorunner mk5 to send goods from different levels,in the correct order, to a palletizer. The Prorunner mk5 can pick up products anywhere and deposit them again at any desired level. Whether you need to transport a container or box from the 3rd to the 2nd or from the 1st to the 4th floor or row: it doesn't matter. Thanks to its intelligent control system the Prorunner mk5 can handle it all. The vertical sorting process starts with automatically scanning the barcode on the product. The control software assigns the product to an empty product carrier and chooses the appropriate infeed point. The same software then ensures that the product is transported to the correct level by manipulating the rollers or string belts of the corresponding outfeed conveyor between the forks of the product carrier at the right moment.



Dyno & Qimarox: Fast and Reliable Partners

Because of their modular construction the Qimarox product lifts can be shipped reasonably quickly, however shipping time can be a month or two. However when being integrated into another system, the manufacture and install time of the conveyors and other machinery means that the lifters arrive at the right time. Generic parts such as product carriers, chains and rollers are in stock, while the steel column consists of standard sections of different sizes that can be assembled easily. Our goal is to be able to deliver complete product lifts from stock. The modular design also results in low transport costs. The Qimarox product lifts may optionally be sent in parts, after which they can be assembled on site. Dyno Conveyors will install the Qimarox lifter and offers consulting for whole system integration. They also manufacture the conveyors and will fully automate the systems with the Qimarox. Contact Dyno for the complete solution from our expert productivity specialists.

About Qimarox

Qimarox is one of the leading players in the market for end-of-line packaging systems. As a manufacturer of palletizers and product elevators and a supplier of professional services, Qimarox distinguishes itself with a contemporary vision and approach, in which innovation, quality and added value are of paramount importance.

About Dyno

Dyno Conveyors are a secure, dedicated team, who enhance the productivity of industries with tailored solutions.

Please visit www.dyno.co.nz to see more information on the Qimarox Lifters and Palletising equipment or give Dyno a call on 0800 144 044.

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