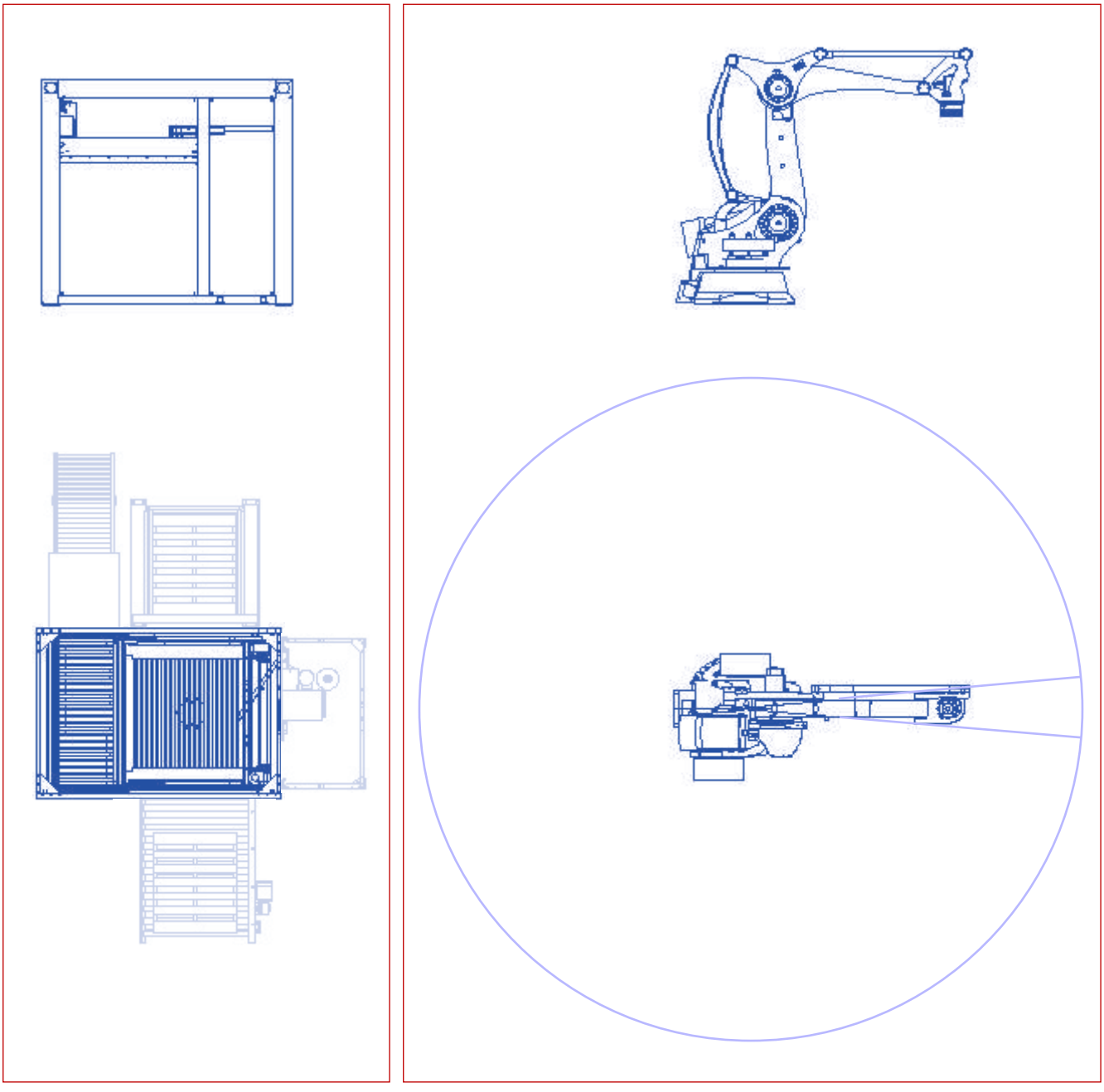
TOPTIER

A Comparison of Conventional and Robotic Palletizers



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Contents

Executive summary	3
Background	3
The problem with robots	3
The TopTier solution	4
Safety	5
Integrated stretch wrapping	6
Multiple line systems	6
Cost analysis	9
RoboTier Hybrid	10
Conclusion	12
About TopTier	13

Executive summary

When introduced in the '80s, robots were the superior solution to legacy layer building palletizers for low to moderate speed applications. TopTier has now revolutionized layer building palletizers with machines that are smaller, safer, equally flexible, and lower cost to purchase and live with than standard robots.

Background

Since their introduction in the 1980's, general purpose robots have proved essential to achieve productivity goals in a wide variety of manufacturing applications. Robots were a natural fit for slow to moderate speed palletizing. High speed legacy palletizers were expensive and bulky, and hand stacking of a standard pattern could be mimicked by a robot by adding special end effectors and creating the control program.

The ascension of robot palletizers into the dominate solution for low to moderate speed palletizing applications occurred with little resistance from existing layer palletizer companies throughout the late 1980's and 90's as they continued to happily dominate high speed applications. Robots provided the capabilities the market demanded such as reasonable cost, compact size, and the flexibility to adapt to ever increasing product changes forced on manufacturers by marketing departments. Robots also provided a new solution with cost justifiable automation for very slow lines by their ability to handle more than one line simultaneously. Layer palletizers remained essentially hard automation little evolved from earlier decades that required excessive space and were difficult to adapt to product changes.

The problem with robots

Robots are not without faults. The outstanding reliability of the servo axis arms is often undermined by customized end effectors prone to reliability issues and often require modifications when products change. Flaws in packaging such as poor sealing, bulging or irregular case forming caused difficulties for the precise positioning robots require.

Required technical support with programming and repair issues often exceeds the capabilities of plant engineers and the cost and delays of relying on outsource support impacts productivity.

Finding the limitations of robotic palletizers unacceptable, TopTier engineers set out to reinvent palletizing from the ground up. TopTier palletizers were developed by engineers with no background in traditional layer palletizers and with direct experience with the real world of robot palletizing. Drawing from decades of machine building experience, there was no doubt a superior palletizing solution was possible based on layer handling principles.

The TopTier solution

Modular design

Introduced to the market in 2001, TopTier palletizing solutions provided innovations in controls and machine design to create layer building palletizers that are smaller, more flexible in layout, safer, and simple to adapt to product changes for a lower purchase and space cost than any robot or traditional layer palletizer solution available in the marketplace.

The core of TopTier technology is very simple mechanical devices packaged into an integral safety cage frame that can be configured into hundreds of layout solutions and able to fit into nearly any production area. Rather than requiring end users to adapt to the limitations of a palletizers design constraints, TopTier thrives on the ability to seamlessly configure standard components into solutions that are more flexible, easier to adapt to future product changes, and lower cost than any competitive offering.

TopTier models are available with capabilities to receive product at high or low levels and handle rates from one to five layers per minute. TopTier's full feature models with optional integrated stretch wrapping accomodate rates from 10 to 50 cases per minute (CPM) and are available in either high or low infeed. Options include sheet insertion, labels-out, and heavy load capability.

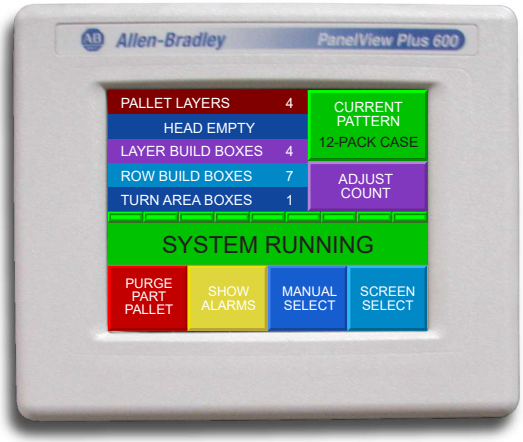
User-friendly controls

Advanced PLC controls allow simple customer programming of new patterns at the HMI using exclusive EasyStack™ software. Utilizing several case turning options, electronic gapping of cases, and a large layer build area with four sided layer conditioning, any layer can be programmed by the end user with minimal training.

In addition to the unique ability for end users to add or change layer patterns, TopTier's PLC program also includes many advanced features that are available on all models because TopTier integrates a single PLC code in all models. The combination of models and configurations allow over a thousand different layouts, yet one PLC code is used throughout. The end result is there is no customization of the PLC code for any solution which provides lower cost for the end user and avoids disruptive de-bugging of code often encountered during start-up of customized PLC code.

Standardized PLC code from TopTier provides no cost value added features such as:

- VFD communications for two speed operations
- retention of VFD parameters with auto reloading of parameters after replacement
- auto back-up of PLC code including all current pattern parameters to a flash card with auto recovery
- advanced error messaging with recovery prompts
- IO mimic screens for advanced diagnostics, and many other features that equal or exceed the capabilities of robot control



The TopTier HMI: simplified machine control and pattern creation

Safety

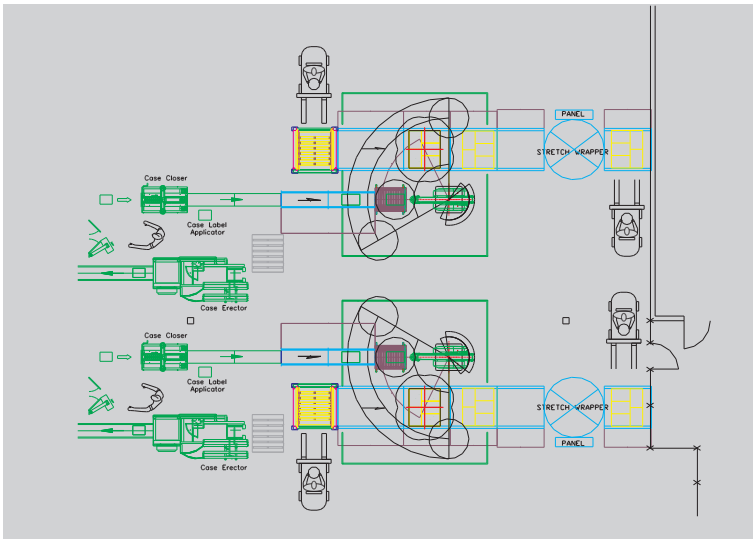
Integral to TopTier controls and mechanical designs are safety features that set the standard for palletizing whether robot or layer style. Standard TopTier designs include full Category IV safety cage frame where all hazards are enclosed. Large access doors are protected by monitored safety sensors and hoist platforms are locked into position by automatic redundant latching systems whenever the access doors are opened. System status is retained and operations resume upon restart. Loads exit though a muting light curtain protected exit. Integrated safety features allows for a smaller overall footprint than add on enclosures required by robots.

Integrated stretch wrapping option

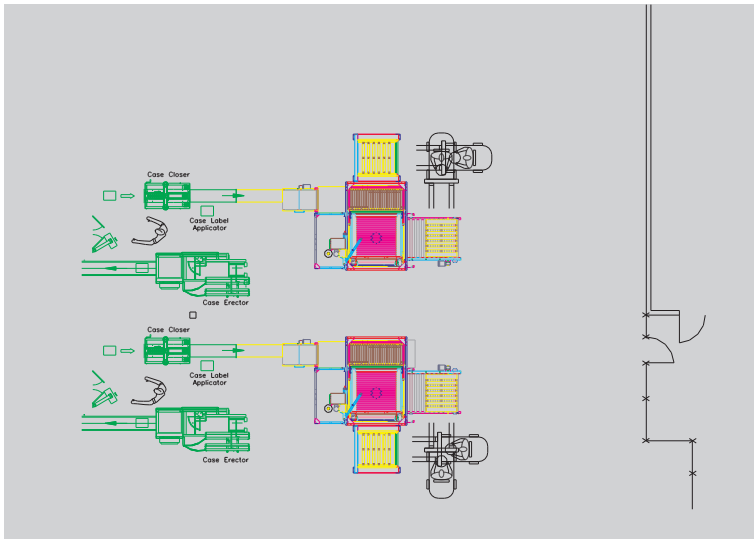
TopTier palletizing solutions are smaller, more flexible, and lower cost than robots. When combined with concurrent stretch wrapping where loads are stacked and wrapped without any additional floor space, TopTier further separates their solutions from robots. Concurrent stretch wrap palletizers from TopTier are lower cost than a basic robot cell, require less space, and provide a completed load ready for shipment.

Multiple line systems

TopTier offers a more cost effective and reliable solution to a single robot serving multiple lines. The TopTier palletizers are faster than a robot and equally flexible. The significantly lower cost permits a dedicated palletizer to be positioned at each line while avoiding single point of failure inherent with a robot and the costs of conveying different lines to a robotic cell. Total throughput potential is also higher due to the ability of each palletizer to operate at higher rates than the shared capacity of a multi-line robot.

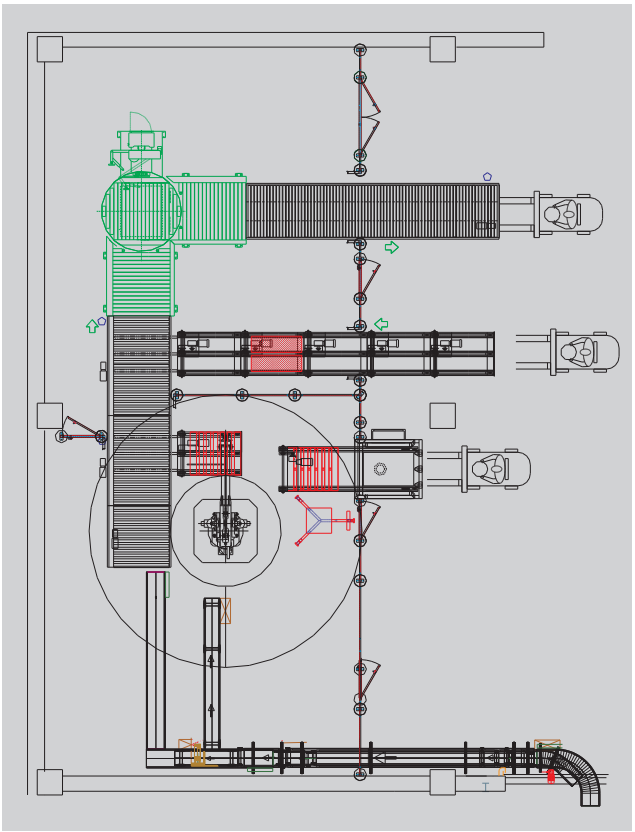


Robot palletizers with downstream dedicated stretch wrap

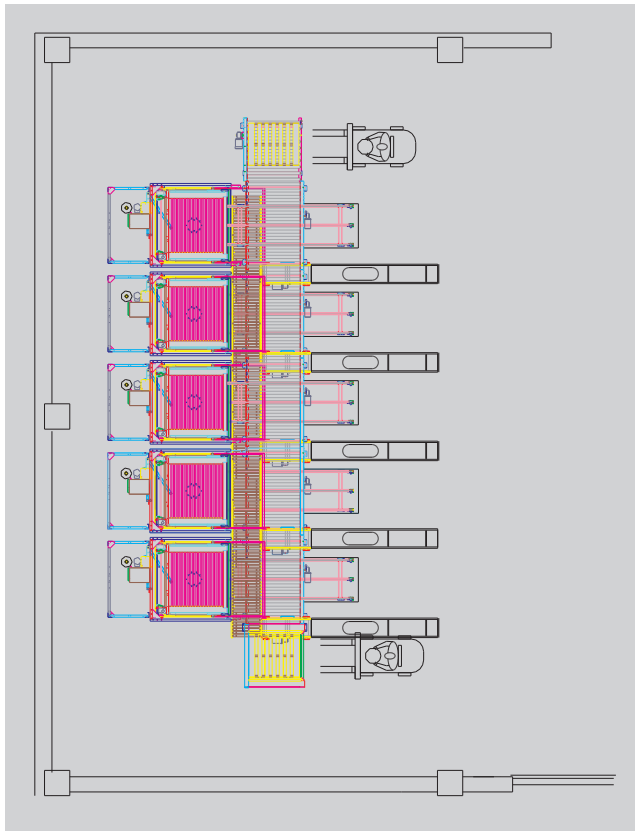


TopTier palletizers with integrated stretch wrap

In a typical layout of multiple line systems with dedicated palletizing and wrapping, TopTier palletizers provide smaller footprint and better forklift access. Both high and low infeed models available.

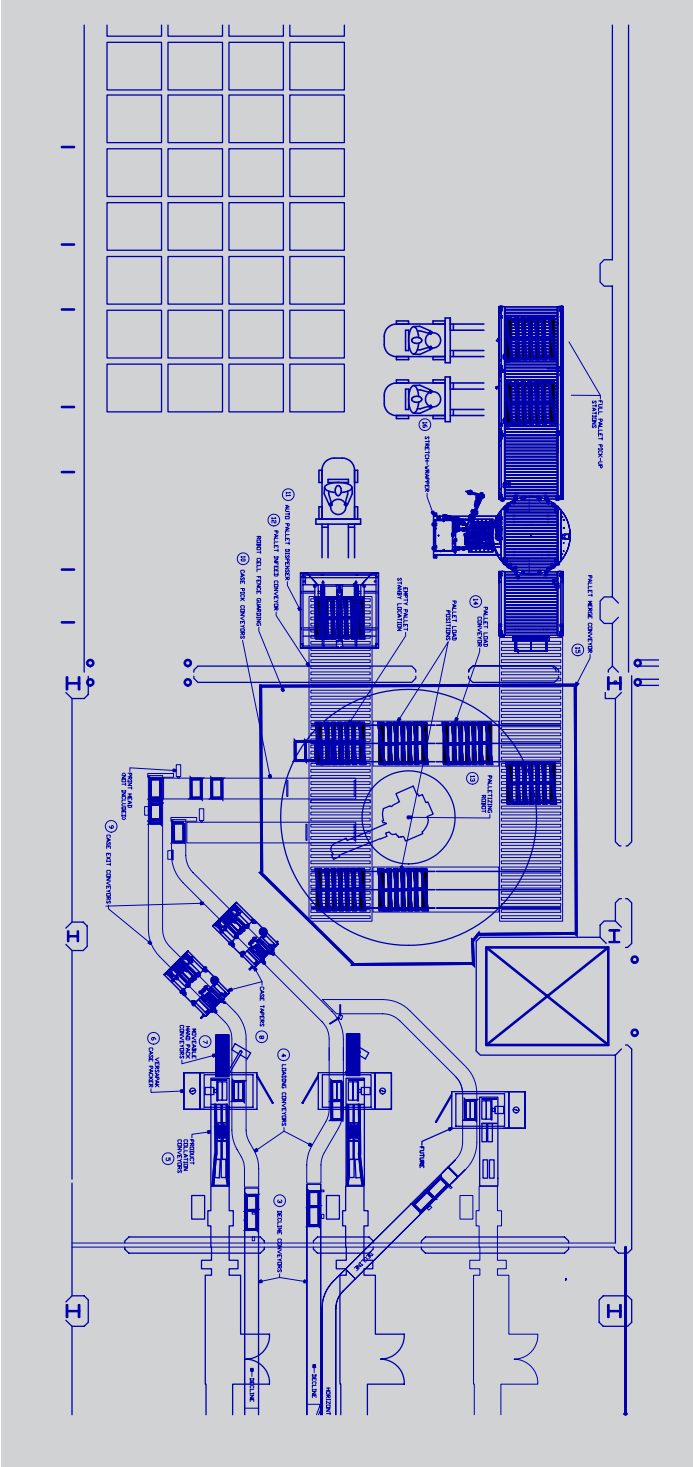


Robot palletizer and downstream stretch wrapper

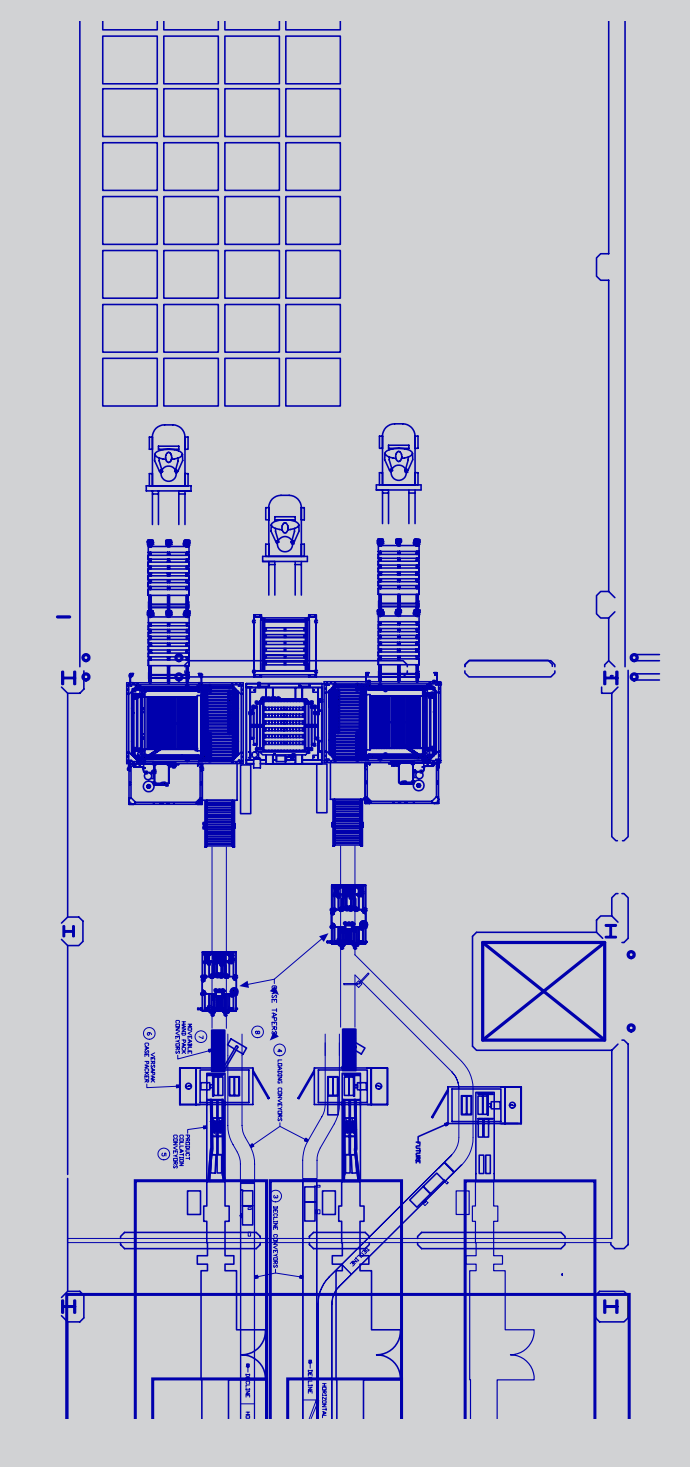


TopTier palletizers with integrated stretch wrapping

In a custom configuration of a multiple line system, dedicated TopTier palletizer modules minimize risk of single point of failure.



Robot palletizer and downstream stretch wrapper



TopTier palletizers with integrated stretch wrapping

In a custom configuration of a multiple line system, twin TopTier palletizer modules minimize risk of single point of failure.

Cost analysis

A cost comparison between robots and TopTier palletizers is an exercise in apples and oranges. Speed is a critical factor, and faster machines cost more for either platform. TopTier palletizers are designed to build layers, while robots are designed to pick individual product. The speed of TopTier models is rated by layers per minute, and the speed of a robot is rated by picks per minute. With TopTier palletizers, the more cases per layer the higher the total cases per minute (CPM). Robots achieve higher throughput rates with special end effectors capable of collecting multiple cases in one pick. Multiple case picks add complexity to the end effecter impacting reliability, induction conveyor and pattern programming. Consequently, robots often perform less reliably when attempting to achieve rates similar to layer palletizers. Entry-level robot palletizer cells are available for $95,000 to $115,000. These models are pre-engineered cells and consist of a robot with restricted reach, simple vacuum picker and enclosure. Entry-level robots generally pick one case at a time at about 8 picks per minute, and the maximum load height is 50".

Higher speed robot systems start at $125,000 to $150,000 for a base cell serving a single line plus $30,000 to $40,000 for a downstream turntable stretch wrapper. Additional lines can be integrated into the base cell at a cost of $30,000 to $40,000 each. Total picks per minute remains constant regardless of the number of lines in a cell so potential CPM per line diminishes as new lines per cell are added. Typical higher speed robots are rated at up to 20 picks per minute, but usually operate at 10 to 12 picks per minute for reliability. Depending on the layer pattern one to six cases per pick are possible depending on the sophistication of the end effecter. Usually one to three lines are handled in a typical cell with some systems handling up to eight lines.

The cost of TopTier's entry-level palletizer is $99,000 . A single palletizer is typically dedicated to serve each line and thereby minimizes the risk of single point of failure. The throughput rate will generally equal a robot servicing a single line while total throughput potential to all lines will be higher using dedicated palletizer compared to a robot servicing multiple lines. Lower cost, less space, and simplified conveyor from the lines are additional benefits.

TopTier models with integrated stretch wrapping and automated pallet handling cost $152,000 - $309,500 and operate at speeds of 1 to 3 layers per minute. With 5 cases per layer the throughput rate is 10 to 12 CPM and with 12 cases per layer the rate is 15 to 30 CPM. Stretch wrapping is performed concurrently, and does not significantly impact rates. These models are capable of multi-

line applications by accumulating loads on conveyor and releasing slugs. Because the cost of accumulation conveyor often exceeds the cost of an additional palletizer, most installations dedicate a palletizer to each line as a lower cost solution and to avoid risks of single point of failure for both palletizing and stretch wrap functions.

Higher speed TopTier models with layer pre-build systems are not suitable for concurrent stretch wrapping because rate potential cannot be achieved with wrapping. Prices without wrapping are $248,750 - $300,750 and throughput is about 20% faster than discussed above.

Hybrid Robot Palletizers

Until recently, robots remained the superior solution for bag stacking applications. Driven by the demand for an alternative to robots for palletizing bags and uncommon products, TopTier introduced the RoboTier® in 2009. RoboTier is a hybrid robot palletizer models combine the best characteristics of robots with the ease of touchscreen programming and control. Using a slave robotic arm dedicated to picking the product, the RoboTier retains the small footprint, layer conditioning, and concurrent stretch capabilities of TopTier's row build models.

RoboTier provides a new level of capabilities and performance — all with no robot programming. Robot palletizing has become an increasingly accepted alternative to traditional layer palletizing, but the solution is not without challenges. Typical robot palletizing experiences limits on products that can be handled, performance issues with deviations in product uniformity, special training to handle complexities of robot programming, large footprint, custom integration, and the expense of support. All these shortcomings have been eliminated by RoboTier.

Technology

RoboTier utilizes end of arm tooling that supports product from the bottom, allowing higher speed robot motion and advanced product handling security. Bottom support offers a significant improvement over typical robot product handling methods such as vacuum top picking that is less flexible and secure, and clamping systems that necessitate looser loads.

Bottom support is achieved by assembling layers on an apron with products loosely spread to allow removal of the bottom support tool. Loose spreading allows faster robot speeds, as exact product

placement is not critical. Once a layer is completed, four-sided clamping centers the layer on the pallet and a tight uniform layer is deposited. Vertical travel capabilities of the apron reduce robot reach requirements allowing use of the smaller, faster, and more economical Fanuc M-710 robot. The layer apron also provides a queuing platform for continued layer building while optional concurrent stretch wrapping occurs.

Controls

RoboTier product handling innovations are enhanced by advanced controls architecture for robot palletizing. A Fanuc controller with very simple code that cannot be modified directs robot motion based on PLC instructions. In effect, the robot is an electronic slave to the Allen Bradley CompactLogix PLC master controller and AB 12" PC Color touchscreen HMI. All automatic and manual palletizer functions are controlled using the HMI touchscreen; robot controls training or experience is unnecessary.

Safety

Safety was designed in from the beginning to meet all industry standards utilizing a Category III safety cage frame design with light curtain protection of load exit, redundant hoist fall protection, Fanuc safety systems, and fiber optic breach detection circuit.

Capabilities

RoboTier solutions are pre-engineered for value by utilizing TopTier modular accessories to meet nearly any low to moderate speed palletizing requirement. Models are available in high or low product infeed in single or dual line configurations. Standard RoboTier palletizers handle cases, bags, bundles, and trays.

RoboTier models include automated pallet dispensing and handle any product from 6" to 36" up to 60 lbs at speeds to 40 per minute, within a footprint of 105" x 90". RoboTier options include sheets and liners, labels out, concurrent stretch wrap, and custom tooling to handle unique product.

Conclusion

For all applications, TopTier solutions outperform standard robots based on:

- cost
- ease of use
- flexibility
- size
- reliability

Many TopTier customers are replacing robots with TopTier palletizers, including Fortune 500 companies. TopTier palletizers have surpassed robotic solutions and are the modern solution for palletizing cases, bundles, and trays at speeds up to 50 per minute. The majority of TopTier customers place repeat orders for additional palletizers.

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About TopTier

TopTier is the leading volume palletizer manufacturer in the US, with sales throughout North America and select countries worldwide. TopTier manufactures palletizers exclusively and serves an elite list of both Fortune 1000 and mid-size companies. TopTier palletizers are engineered and built in a vertically integrated manufacturing facility located in Portland OR, USA. TopTier is a member of the Packaging Machinery Manufacturers Institute (PMMI) and the Material Handling Industry of America (MHIA).

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