The Top 10 Robotics Application Mistakes

By George E. Martin, Bosch Rexroth Corp.

As robot technologies continue to improve and evolve, the choices facing today's robotics buyers continue to expand as well. How do you know what type of robot to choose? How can you avoid mistakes that you may not be aware of, even if you've successfully applied robotics technologies in the past? With investments ranging from tens of thousands to potentially millions of dollars, it's critical to make the right choice the first time and to avoid common mistakes that could add substantial unnecessary cost or result in project delays. To help engineers and manufacturing personnel avoid the worst pitfalls, I've listed the top ten robotics application mistakes I've seen in my 20 years in the automation business.

Assembling parts on a workpiece pallet requires repeatability, but not necessarily extreme accuracy.

Mistake 1: Underestimating Payload And Inertia Requirements

The No.1 application mistake made by robot users is underestimating the payload associated with a given application. The most common cause is failure to include the weight of the end-of-arm tool in the payload calculation. The second most common cause is underestimating or completely ignoring the inertia forces generated by off-center payloads. Inertia forces can overload a robot axis. It is very common to overload the rotational axis on a SCARA robot. Failure to correct the problem also may cause damage to the robot.

Reduction of payload and/or reduction of speed parameters could remedy the situation. Reducing the speed, however, may cause an unwanted increase in cycle time – a cycle time which may have been part of the ROI calculations in justifying the purchase of the robot in the first place. That's why it's critical to consider all load-related factors from the very beginning.

Mistake 2: Trying To Do Too Much With the Robot

Sometimes the awesome capability and flexibility of a robot can cause a designer to over task the robot and make the work cell too complex. The result once again could be failure to make cycle time, or it could lead to extremely difficult programming solutions or even to difficulties with processor speed limitations. This mistake is further magnified when users other than the system designer try to troubleshoot the work cell once in production. Unplanned down time can be very costly in a production environment.

Another common manifestation of over tasking the robot cell is known as Project Creep — adding work beyond the original tasks for which the robot and work cell were designed. This can be especially disappointing if the additional tasks are added after a simulation has been performed verifying the original assumption. If no new simulation is done before proceeding with the project, the intended cycle time may not be reached. Be careful not to increase the scope of work of the work cell beyond the robot's capability within a given cycle time.

Mistake 3: Underestimating Cable Management Issues

As simple as it may seem, cable management is often overlooked, possibly because it seems so simple. However, optimizing cable routing to end-of-arm tooling or peripheral devices is crucial for unrestricted movement of the robot mechanic. Failure to design out this potential problem can lead to unnecessary movements of the robot to avoid tangling or stressing wires. Also, failure to use dynamic cables or to minimize cable stresses can lead to broken wires and down time.

Mistake 4: LOSTPED or Failure to Consider All Application Elements Before Choosing A Robotics System

Bosch Rexroth uses the acronym LOSTPED to describe the application elements required to size a mechanical system. By working through these considerations for each application, you will be sure to consider the application from every possible angle and to avoid mistakes during planning that could result in severe cost overruns when the system is installed. The LOSTPED elements are:

Load – consider the payload, orientation and moment;

Orientation – consider the plane of travel, potential obstacles in the plane of travel and any impact on lubrication and maintenance;

Speed – consider speed, acceleration and deceleration and the inertia they create;

Travel – consider the length of travel, alignment, lubrication intervals and potential ball screw whip;

Precision – consider travel accuracy and final position;

Environment – consider environmental temperature, cleanliness and the presence of corrosive agents;

Duty Cycle – consider the proportion of time operating and not operating and any thermal effects on components.

Mistake 5: Misunderstanding Accuracy Vs. Repeatability

An accurate mechanic can be repeatable but a repeatable mechanic may or may not be accurate. Repeatability is demonstrated by returning accurately to a taught position point in the work envelope of the robot. Accuracy is demonstrated by moving precisely to a calculated point in the work envelope. Pallet commands use a robot's accuracy capability by calculating an array of robot positions based on a few taught points. Accuracy is directly related to the mechanical tolerances or precision of the robotic arm.

Mistake 6: Choosing a Robotics System Based Solely On The Control System

Most robot manufacturers would agree that much more consideration is given to the robot controller than to the mechanic. This is ironic because once the robot is deployed, the uptime is mostly dependent upon the robustness of the mechanic. Loss of production throughput is less likely to be caused by a broken controller, an electronic device, than by a broken mechanic. Most often a robotics system is chosen based on the familiarity of the user with the controller and the software. If the robot in question also has

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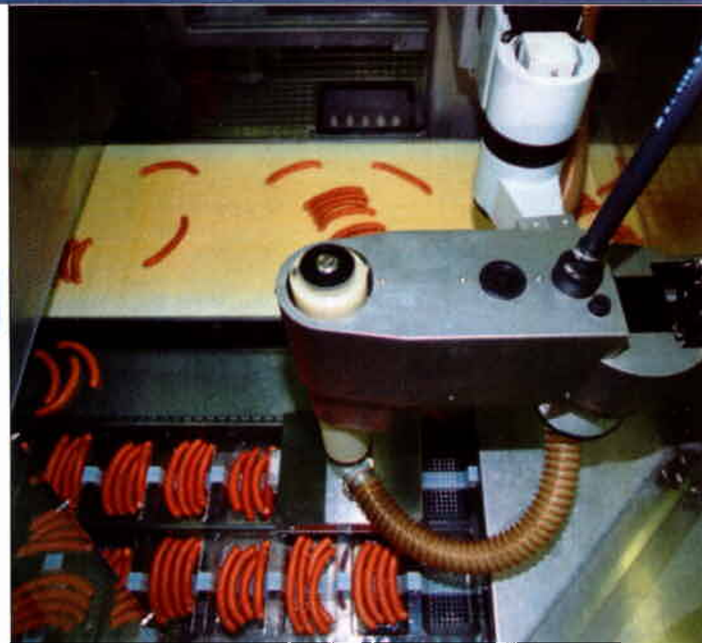

This sausage-handling robot was modified in advance to handle the known environmental and handling issues associated with food.

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a top-notch mechanic, then this is a competitive advantage. If, on the other hand, the robot needs constant servicing after installation, then any time savings from controls familiarity will quickly be squandered.

Mistake 7: Failure to Accept Robotics Technology

A machine builder or an integrator may create a robot work cell adequate for an application, but if the end-user fails to embrace the robotics technology, the project will be doomed to failure. The uptime of any production equipment is directly related to how well users understand the equipment and to their ability to maintain the equipment. The same is true for robot technology.

It is not uncommon for new robot users to refuse robot training. Fully understanding the capabilities of a robot and best practices for a given brand is crucial to a smooth integration.

Mistake 8: Overlooking the Need for Crucial Robot Options or Peripheral Devices

Teach pendants, communication cables and even special software options all are examples of items that may be needed but forgotten at the time of the initial order. The lead time for such items and the cost may delay the project and cause it to go over budget.

Be sure to compare competitive robot products accurately before purchase and to consider all aspects of integration and the need for any optional equipment. It is not unusual to see users attempting to save money by integrating a robot without options critical to the robot's overall performance.

Mistake 9: Under- or Overestimating the Capabilities Of a Robot Controller

Underestimating the capabilities of a robot controller can lead to duplication of systems and the incurring of unnecessary costs. Duplicating safety circuitry is very common.

Overestimating controller capabilities can lead to additional equipment costs, rework and costly delays. Attempting to control too many I/O, additional servos or simultaneous routines is a common mistake.

Mistake 10: Failure to Consider Using Robotics Technology

The size of the initial investment, lack of familiarity with robot technology and past failed attempts all are reasons that people sometimes shy away from using robotics technology. To improve productivity and gain lasting competitive advantage, however, it's important to look beyond misconceptions such as these. While it's true that robotics are not the answer to every single productivity improvement, robots certainly can help in many situations.

Time to market, increased productivity, operating simplicity, flexibility, reusability, dependability, precision, controls capability and the long term cost of ownership all are strong reasons to use robotics technology.

But Wait, There Are More

The above list represents a selection of mistakes that I've seen most frequently, but there are many others that easily could have been included in the top ten list, such as failure to consider future applications for the robot; choosing a robot solely on price; not understanding the full capabilities of the robot before implementation; not fully utilizing the robots capabilities; believing robotics are too complicated; and believing there is a perfect robotics system.

Whatever your robotics task, the best advice of all is to work very closely with your robotics supplier and system integrator. The better they understand your needs, the more likely you will be to receive a system that can perform exactly as you'd like it to. May acknowledgement of these top ten mistakes serve as a starting point for those discussions. RW

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Upfront simulations and drawings can help visualize clearance issues to allow for a compact cell design, like this one.