Life Cycle Costs and Integrated Door Systems

Traditional door and hardware may require up to fifteen manufacturers and four different trades with blurred responsibility, to fill a hole in a wall. The integrated systems approach taken by Total Door says there should be one manufacturer that provides all the materials, installation, and full responsibility for the functioning of the door. All work should be completed in compliance with the specification and all relevant legal requirements. Doors should be installed on time, every time, under a sole source of responsibility. As someone responsible for the doors in your school, you well know that you will live with the doors long after they have been installed.

When we think of life cycle costs, we usually think in terms of taking the cost of a product and dividing it by the life expectancy of the product to get the amortized cost per year. As an example, a $1,000 purchase with a 10 year life span equals $100 per year. This sounds logical but is inadequate for making comprehensive product comparisons. To identify life cycle costs we need to take into consideration a number of variables.

1. When evaluating operating/industry cycle standards:
    - How does the real-world environment vary from that of the test laboratory? In other words how reliable are test standards?
    - What is the impact of the careful selection of components, adjustments and lubrication, and real-world abuse conditions?

2. How is the failure rate affected by?
    - Quality of the installation.
    - The number of parts.
    - The type of fasteners used.

3. What are the true values of avoided costs?

Mean Time to Failure and the Test Environment

Most door and hardware manufacturers reference the ANSI standards their door components meet. But what does this mean in the real world? Let's use the ANSI standard for Grade 1 Panic exit devices which is currently 500,000 cycles.

The BHMA/ANSI performance level of 500,000 cycles is developed by testing in laboratory conditions, on carefully selected product, with perfect installation, zero abuse, gentle operation and perhaps with occasional adjustments.

Compare this to the last installation you witnessed. Were all the components installed by factory trained technicians? Did they carefully pick through the components and make sure they

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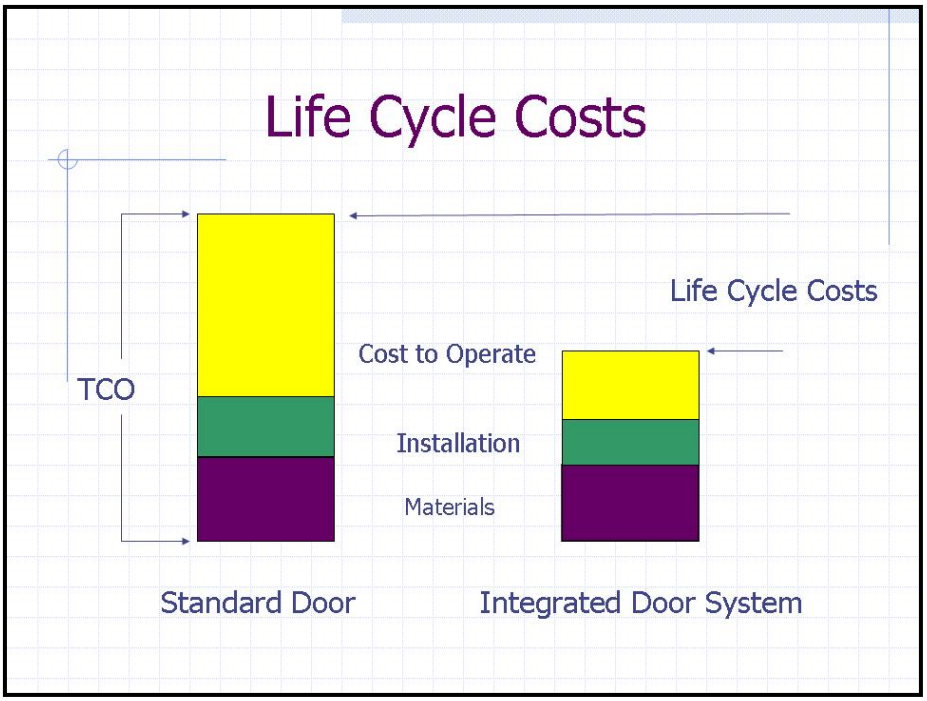
discarded any part that did not meet the highest standard? Do your students gently open and close your doors?

Now we can begin to see how field operating cycles can differ significantly from published test standards due to the quality of the installation and installed parts. You may get the journeyman installing parts or you may get the apprentice. They're typically working in dark, dirty, noisy conditions with lots of other trades running around. This might explain why your maintenance budget is so high early in the life of your doors because the mean time to failure occurs early in the doors life cycle. Eventually you get the bugs worked out but you have exhausted your budget.

We would like to demonstrate how a systems approach to these and other issues can dramatically reduce installation, and hardware issues.

The following chart highlights the key components of a life cycle cost comparison. We must have a full accounting of three key components.

1. The initial cost for the door and hardware materials.
2. Installation costs.
3. Our best estimate of future operating and maintenance costs.



Life Cycle Costs (also referred to as Life Cycle Costing and Life Cycle Analysis) is the comparison of the "difference" between the total cost of ownership of two or more similar items.

This gives us the Total Cost of Ownership (TCO) for a given product. Life Cycle Costing measures the difference between the TCO's for similar products. Financial analysts often will also apply a capitalization formula to the Life Cycle Costs in order to show the value in dollars based on a specified rate of return for their organization.

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Number of Parts

The next chart provides a comparison of the list price of a standard Grade 1 vertical-rod panic device and the price of an equivalent Total Door panic device. You might ask "How can they both meet Grade 1 standards yet the vertical-rod panic costs four times more than the system panic?" The answer lies in the number of parts required to accomplish the same function - 150 plus parts for the standard door hardware versus 13 on the integrated door system. The reduction in the number of parts is achieved by integrating the function of the panic within the door. Put simply, all we need to do is unlatch the door.

Comparison of the number of parts and the number of parts handled.

	GRADE 1 VERTICAL ROD PANIC DEVICE		TOTAL DOOR SYSTEM
List Price	$1,250		$310 (3hr label)
Typical Selling Price	$750		$200
Net Difference		$550	
Number of parts	150+/-		13
Ratio	100%	Vs.	9%
Number of panic parts handled by the installer	69	vs.	0
Life cycle expectancy	500,000	vs.	5,000,000

We must also note that the number of parts handled by the installer is equally significant – 69 parts for the standard door versus 0 for the Total Door. Why are there zero parts handled? Because as part of the integrated systems approach, the panic device is preinstalled at the factory instead of being installed in the field.

Product Issues That Accelerate Failure

The door and hardware business has been historically slow to accept new ideas. In many cases we see hardware configurations used because at the time they were developed it was the best solution for a given problem. Unfortunately there are better answers today but it can be difficult to change from things we are used to.

The **cushion stop closer arm** is a real door, frame and hinge buster. Opening the door until it is stopped by the arm and then pushing hard on it will absolutely cause door and hinge failure. The primary forged steel arm is stronger than the other door components. This same arm will not harm a Total Door because the hinge is strong enough to cause the primary arm on the closer to bend in the strong plane before it can damage Total Door components.

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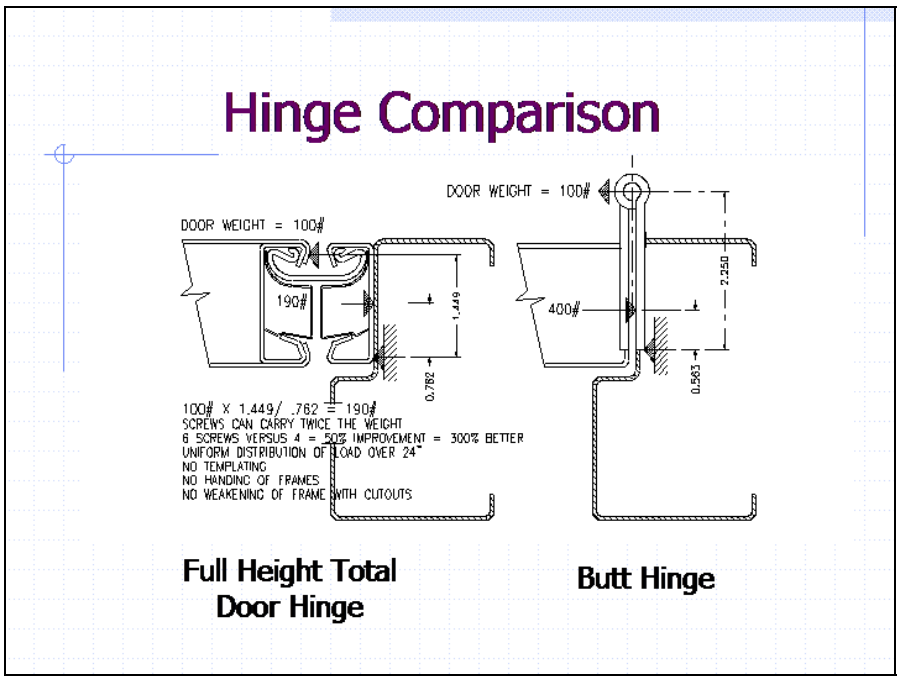
Surface mounted vertical rods are bare, exposed and very easily damaged by carts or intentional abuse. **Concealed vertical rods** are an abomination as far as facility maintenance is concerned. They are difficult and time consuming to repair. The architect and owner often face a dilemma trying to choose between these two undesirable options. Total Door system does not need or use vertical rods.

Coordinators and auto flush bolts which have only 10% to 20% of the life of other door components are prone to early failure. Total Door does not use coordinators or flush bolts so we also eliminate them as a point of failure.

How Hinges Accelerate Failure



Hinge design has a major impact on the life cycle costs of a door.

On the right side of this detail we have a horizontal cross section of a standard 4-½" x 4-½" heavy duty, ball bearing butt hinge. The frame must be weakened in three locations in order to mortise the hinge leaf, necessitating the welding of hinge reinforcements to the remaining frame. The force is transferred to the frame via the hinge pin which multiplies the loads on the screws by a factor of four. This is why hinge reinforcements begin failing before reaching one million cycles. [*The 100 pound door load x 2.25" (center of pin to edge of leaf) divided by .563" (center of screw to the edge of hinge) equals 400 pounds.]*

What happens to the door, frame or hinge when someone leaves a wedge or broom handle in the hinge jamb and then tries to close the door? Obviously this creates a leverage point the door was not designed to support. This action will produce failure of the reinforcements, door, hinge or

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frame. [*This example assumes that the broom resistance point is 1" from the hinge pin. 20lb closing pressure x 36" door width x 2.25 " / .563" = 2,877lbs.]*

The high strength, stainless steel support ribbon used in the Total Door hinge system eliminates one of the major causes of failure – friction! The hinge geometry allows for rotation along the hinge axis point so that the forces caused by door weight are not multiplied as they are with the four butt hinge. The Total Door hinge is also more secure because the pivot point runs the full height of the door. In addition, the full height design of the hinge eliminates the ability to insert a broom between the door and frame to prop it open, with typically disastrous results.

Fewer Parts mean Fewer Problems

Total Door reduces failures and has a positive impact on life cycle costs by:

- Eliminating 87% of the screws found in the competing panic exit device
- Dramatically reducing the number of manufactured parts in an opening by eliminating vertical rods, coordinators, astragals and flush bolts.
- Using a systems approach and installing all the hardware at the factory.

Here is a side by side comparison of a Total Door system next to a conventional door. What you also see is the way these ship from the factory. The Total Door is completely assembled while the regular door will ship in individual pieces. In fact, all the pieces you see in the picture on the right are for just one leaf!

The number of parts has a dramatic effect on reliability and maintenance requirements of a door. The Total Door as a whole uses 67% fewer parts, vastly improving its reliability. This is particularly important when you consider that for the Total Door full height hinge, out of 19 parts, 15 are self-drilling, self-tapping screws – the hinge system itself is made up of only four parts.

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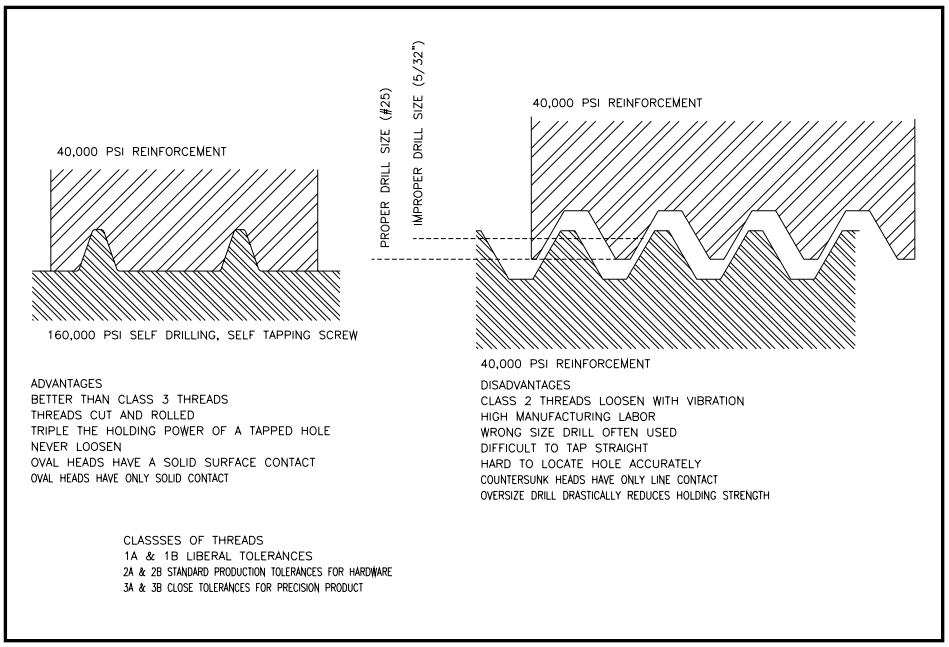
Self-Drilling, Self-Tapping Screws



The use of self-drilling, self-tapping screws is critical as they have proven to provide superior strength and resist loosening. This superiority is due to the fact that the self-tapping screw partially cuts and partially roll forms the mating thread for superior contact. Compare this to the requirements for drilling and tapping a field installed machine screw. Just by using a 5/32" versus a #25 drill bit for a #10/24 tapped machine screw (a difference of only 0.007!) we would reduce the holding capacity to about 10% of the intended rating. A 700# holding capacity has been reduced to 70#.

Installation

As we have demonstrated, not only are the number of parts dramatically higher with standard hardware but the number of parts handled by the Total Door installer is significantly lower. Fewer parts handled means less installation time and fewer opportunities for something to go wrong. When comparing Total Door to "other doors", it is important to look at the total cost of installation. Total Door simplifies installation because it is an integrated door system, with all the hardware pre-installed at the factory.

The following example of installation time for a sample door is taken from the 2002 R.S. Means – Building Construction Cost Data. You can use this list as a guideline for comparing the total cost of your door installations.

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R.S. Means sample installation hours

Example 3070 Interior Door

	Labor Hours Other Doors	Labor Hours Total Door
Install and Swing Door	0.941	0.941
Kick Plate	0.533	0.0
Lite Kit Glazing – 1 sq. ft.	0.860	0.0
Panic, Vertical Rod, with Exterior Trim	2.000	0.0*
Surface Closer with Standard Arm	1.333	0.333 adjust only
Total Hours	5.667	1.274

4.393 more hours for the "other" door!

Note: The time for Panics/Vertical Rod and Exterior Trim should be reduced by 1 hour if using mortise locks vs. a panic. (1 hour vs. 2 hours) Total Door labor hours are based on the use of Total Door hardware. Your times may vary based on additional features and door configurations.

And you don't need to worry about:

- Hardware Rooms
- Shrinkage
- Supervisor Time
- Coordination of Assembly Activities
- Space Requirements

Capitalization of Life Cycle Costs

Some of you may face "hurdle" or capitalization requirements for capital improvements. If this is the case we need to identify the maintenance and/or repair costs that are reduced or eliminated over the timeframe you select. For example, let's assume the time horizon is seven years. During this time you may need to replace a panic exit device on a standard door. Because of the higher cycle count and lifetime warranty on the Total Door you would not have this same expense. If it costs you $750 for the part and $230 to install a replacement, your total avoided cost is $980.

However, this $980 is in the future and you need to determine what it is worth today. When determining capitalization we annualize the costs savings and divide by the selected capitalization percentage (For this example 15%).

$980 / 7 years = $140/yr
$140 annual savings/.15 = $933

If there are also cost savings on the initial purchase these must be added to this value to give the full value of your life cycle cost savings.

Example:

Let's say the hardware and installation labor savings on the Total Door come to $500. (Remember the hardware is installed at the factory and because of the simpler mechanism has

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fewer parts). When added to the $933 from above we see our total life cycle savings equal $1,433.

Conclusion

What Factors Lower Maintenance & Life Cycle Costs?

1. Fewer but higher quality components.
2. Eliminating fasteners and where they are required, using self-drilling, self-tapping sheet metal screws instead of field drilling and tapping.
3. Factory assembly and hardware installation.
4. Applying a systems approach to the design and manufacture of the door and hardware.
5. Local service with single source responsibility.

Here are some examples that highlight these points.

- Panic device - 13 vs. 150 components; 5 screws vs. 42 screws
- Factory installation of panic, 0 field hours vs. 2 hours in the field
- A typical opening can have as many as 15 manufacturers.
  Frame, hinge, door, lock, panic, coordinator, astragal, threshold, stops, flush bolts, kick plate, closer, lite kit, glazing, gaskets and sweep.

  And 4 trades
  Drywall (Setting Frames)
  Carpenter
  Painter
  Glazer

The local Total Door Distributor sells, installs and services Total Door. Single responsibility means no finger pointing, especially for issues like code compliance, ADA guidelines, and reliable function.

Through this article we have hoped to educate on the advantages of the Total Door system. However, this same analysis could be applied to any major purchase you are considering. You could buy a kit car if you wanted to, but I think most of us would prefer to buy a car already assembled and ready to drive off the lot. Total Door has brought this same philosophy to the door and hardware business. We hope you enjoyed this white paper and look forward to any questions or comments you may have.

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