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What cost migration?

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Here is an easy return-on-investment tool for evaluating the price to upgrade a control system

Let's face it, the traditional maintenance strategy of "if it ain't broke, don't fix it" is increasingly beginning to result in unscheduled outages in many process plants today.

In addition to human machine interface (HMI) hardware, that has a life cycle much less than that of the plant floor hardware and needs to be migrated, control systems have begun to approach their projected lifespan and require replacement.

The reasons for replacement of the system are not just for the value of today's technology, which clearly exceeds anything that was built 10 to 15 years ago, but because many of the older control systems do not have the safety, reliability, security, and/or supervisory controls tools that can keep you competitive in today's global marketplace.

FAST FORWARD

- Knowing when to wait is just as important as knowing when to upgrade.
- Clearly define the costs, risks, and benefits you can expect during the migration process.
- This graphical method makes the comparison of migration solutions clear.

In fact, if the HMI of your current system is more than five years old, it is time to think about a replacement. In many cases, plants and factories today plan a total replacement of their entire system from the field wiring up to the HMI with a newer system using the latest technology.

However, that is not the only alternative to upgrading or migrating.

What is difficult is knowing when to act, or not react, with a system upgrade or migration. The details of each pathway are many. Here are 10 migration routes one should consider when planning and moving to newer technology:

1. HMI connectivity
2. HMI conversion
3. Special application (i.e. batch) integration
4. Controller gateway
5. Application library
6. Application conversion
7. I/O gateway
8. I/O replacement
9. I/O interface
10. Field termination adapter

Each of these pathways has an associated risk, cost, and value. For example, the HMI connectivity and HMI conversion could have high value, with low risk and cost. The return on investment of any of these pathways is the incremental value divided by the incremental cost. Evaluate the risk, and add it to the cost.

Change matrix

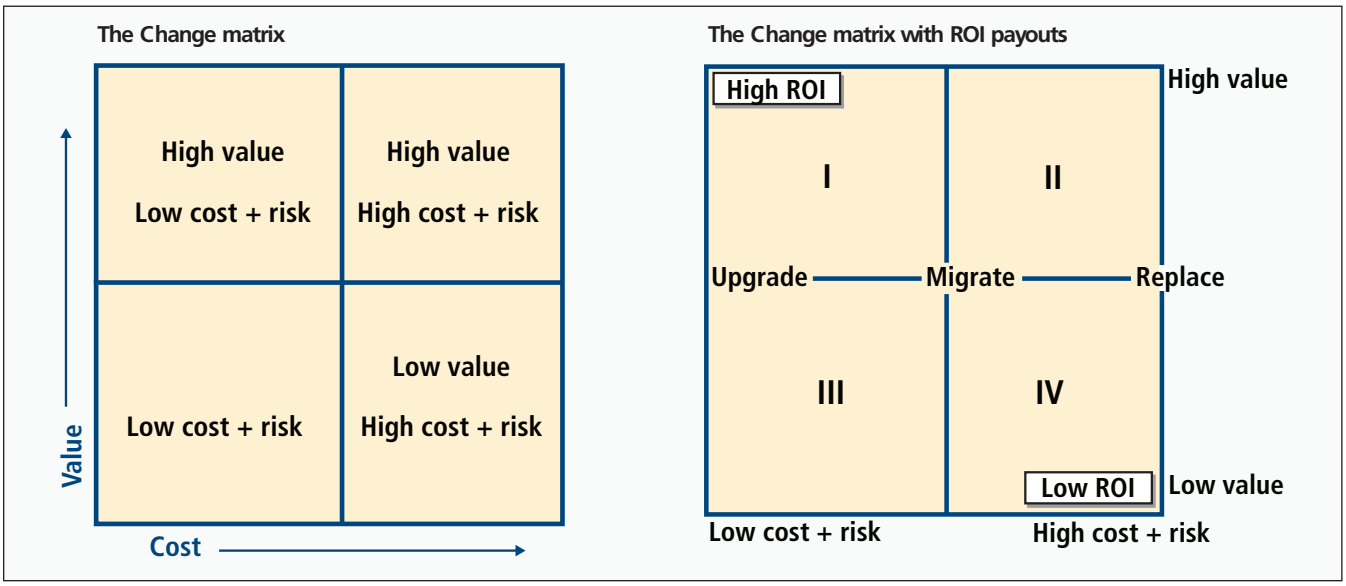
One way to evaluate the choice between options is to use a simple, two-dimensional graph to illustrate different return on investments (ROI). This method uses a matrix that consolidates various results of the risk, cost, and value evaluations.

The "Change matrix" has four quadrants. Quadrant I represents the area with the best ROI. Quadrants II and III have about the same ROI, and quadrant IV has the worst ROI.

Going from left to right, the matrix has the labels "Upgrade, Migration, and Replacement" representing the scope of the change to the system. Therefore, the matrix is a graphical way to evaluate low and high ROI and determine the range of change from upgrade to replacement.

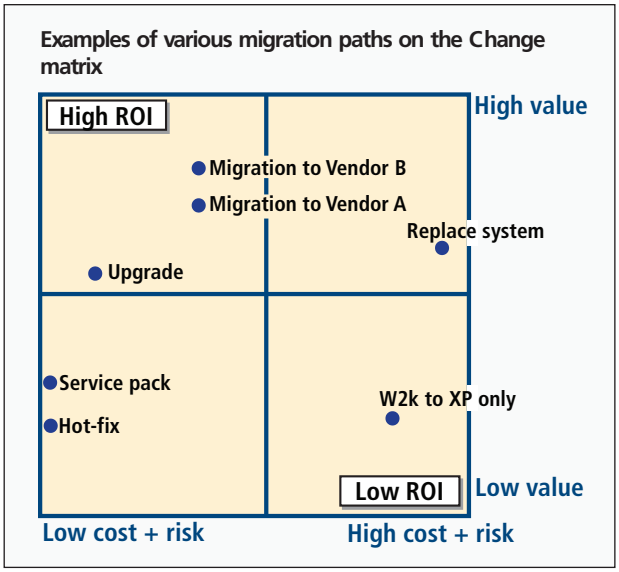
Changes are upgrades if the risk and cost is small; migrations if the risk and cost is larger; and full replacement if the cost is the maximum.

This matrix does not declare an option to be good or bad solely based on the



horizontal position of the option, but it does indicate a better or worse ROI based on the diagonal position of the options in relation to each other.

The closer the ROI is to the upper left of the matrix, the better the ROI. This matrix works well to decide between two similar options. For example, one can compare a full replacement from vendor A with a full replacement from vendor B. The result of the analysis is on the matrix graphically, and therefore the higher ROI option is clear.



A typical hot fix would be in quadrant III, because the value is relatively low (unless the fix helps a mission critical operation), and the cost is low (usually free).

An upgrade with high value and low relative cost would be in quadrant I; a migration with high value and risk would be in quadrant II; and a forced migration for reasons unrelated to the process system would be in quadrant IV.

An example of the latter would be a case where the plant's IT department requires the installation of a new computer or operating system in the control room for security or for corporate compliance and consistency reasons.

There is no benefit concerning the control system per se and only a high risk of losing the window to the process for a period of time.

Weights of importance

In this case, the matrix will evaluate two different system migration options.

The X-axis of the matrix represents the cost of the system change in terms of percent of budget plus a risk factor of that change. A change that cost the budgeted amount that also has zero risk would sit halfway across the X-axis at the 50 mark.

A change that cost the full budgeted amount but is also risky, would sit on the right side of the X-axis. If the X-axis has a scale of 0 to 100, we can calculate the exact position of the change on this axis by the following formula:

X = cost + risk

Let's look at a system that is five years old and needs an upgrade to newer HMI.

Vendor A, who supplied the original system, has an HMI upgrade available. Common weightings and values need to be set for the migration, and then the position on the axis can be determined. Start with the risk component of the X-axis position.

We list each risk criteria and give a weight of importance from zero to one. Then we assign the score for each criterion. Multiply the weight by the score to get a weighted score. Here, we will use these criteria:

1. Only half the system receives testing? 100 = yes to zero = no.
2. After installation only half the system gets support? 100=yes, zero=no.
3. The chance there will be a complete loss of the view to the process? 100 = 100% chance, 0 = 0% chance that will happen.
4. The engineering of the graphics needs to be re-engineered (double work) due to technical or other

Risk

Risk based on technical features and relationship with vendor (lower number is better in the score column).							
		A		B			
Criteria	Weight 0-1	Score 0-100	Weighted score	Score 0-100	Weighted score	Best score	Best weighted score
Half system tested	1	0	0	100	100	100	100
Half system supported	1	0	0	100	100	100	100
Loss of view to process	0.9	0	0	0	0	100	90
Re-engineering application	0.8	20	16	80	64	100	80
Totals			16		264		370
		Normalized score	4.32		71.35		
		0-50 score	2.16		35.675		

reasons? 100 = 100% chance that will be required, 0 = 0% chance that will be required.

These criteria also receive weights of importance:

1. If the system is tested fully at the vendor A's factory, then there is less risk than if the system is never fully tested. This is a very important risk factor, and the plant has decided to give this a one (1), the highest weighting.
2. Ongoing support is also very important and given a one (1) weighting too.
3. Loss of view to the process is important but not as critical as the previous two criteria, so it gets a weighting of 0.9.

a 50, and the least risk score (best risk) would be a zero.

We repeat the process with vendor B. Say vendor B sells only the HMI portion of the migration and will not test the entire system. They will also only support the HMI software. Therefore, their scores are high for those risks.

In addition, because the HMI is not tightly-integrated with the controller, the risk that re-engineering is required is high. The risk score for vendor A is 2.16 and vendor B is 35.675. These risk scores will add to the cost after we figure it out next.

The cost is easy to determine and is not subjective. Divide the cost by the

The X-axis position for vendor A is: X = cost + risk, therefore, 43.75 + 2.16 = 45.91.

The X-axis position for vendor B is: 18.75 + 35.675 = 54.425.

We determine the Y-axis of the matrix similarly.

Y is the value score of the new system and the migration strategy. This is the value of the features and benefits derived in a similar way as the X-axis. For example, if the new system features new security attributes that are CFR-11 compliant and alarm management could lower the cost to operate the plant, then the value would be high. It is up to the plant personnel to determine the

Cost

Cost based on difference from budget		A		B	
		Price vendor A	Percent to budget	Price vendor B	Percent to budget
Budget amount	$40,000.00	$35,000.00	88%	$15,000.00	38%
		0-50 score	43.75		18.75
Risk plus cost score (0-100)			45.91		54.425

4. Re-engineering the application is a risk factor but given a 0.8 weighting.

Here is a spreadsheet showing these numbers. Finally the weighted scores are added together and divided by the best possible weighted score to get a normalized score (zero – 100), which is then divided by 2 to get a score between 0 and 50. This is so the cost score (also 0-50) can add to the risk score to get a total score for the X-axis of between 0 and 100. The most risk score (worst risk) would be

budgeted amount to get a score relative to the budget. The budget for this project is $40k. Vendor A comes in at $35k, vendor B at $15k. At first glance, vendor B is the better choice because of the lower cost. After dividing the cost by the budget, we get a cost score. Vendor A is 88% of the budget multiplied by 50 to get the 0 to 50 score of 43.75. Vendor B's score is 18.75. These cost scores add to the risk scores to get the X-axis position for each vendor.

feature score and weighting. These can rely on any criteria but must be consistent across all evaluated systems.

To set the Y-axis position using the same premise of the X-axis example, weighting and listing the features, obtaining a score and normalized it to a number between 0 and 100.

For example, vendor A's Y score is based on criteria that the plant requires or would like to have. In this case, they would like to have the following value items:

Migration

Value of migration solution							
		A		B			
Criteria	Weight 0-1	Score 0-100	Weighted score	Score 0-100	Weighted score	Best score	Best weighted score
Save 10% operation cost	1	80	80	70	70	100	100
Security features	0.9	90	81	90	81	100	90
Easy to migrate tags	1	90	90	90	90	100	100
Graphic conversion	0.8	90	72	90	72	100	80
Totals			323		313		370
		Normalized score	87.3		84.59		

Risky business in control

There is a range of system upgrades and changes one can perform on one's control system. Here are a few.

- **Hot fixes:** A minor change to the software by replacing one or more files while the application is running … may or may not require a re-boot … solutions are usually low risk with comparatively low value done while the plant is running
- **Service packs:** Minor upgrades to the base software that may or may not include new features … installing Service Packs are low risk with medium value depending on the need of the user
- **Upgrades:** These are usually more involved than hot fixes, but are contained in scope and have some higher value return based on the offering. Upgrades offer some additional risk but usually much higher value than Service Packs.
- **Migration:** It involves many different solutions at many levels, each with a unique ROI. Some solutions may involve low risk if done with standard products while others using custom solutions would involve higher risks. The value of the migration depends on the weight given to each additional feature in the newer system. Normally the value of migration is higher than an upgrade.
- **Replacement:** This is highest risk option, but it could also have a high value component depending on the solution.

1. Save 10% on operating costs after the migration
2. Security features to comply with regulatory requirements and internal IT department requirements
3. Ease of migrating the tags from the old HMI to the new HMI
4. Graphic conversion tool required to maintain the look and feel of the old graphics on the new system so the operators have minimal training requirements

Each criteria receives weight, then vendor A's scores go in, and we determine a weight and then normalize 0 to 100. We do the same for vendor B and determine the Y-axis position for both (87.3 for A and 84.59 for B).

Plot these two points on the graph for comparison.

In a real-life situation, it is important to evaluate all criteria. This will insure even a small difference on the graph is significant and will identify a definitive choice. This example for the X- and Y-axis is useful for comparison to any other migration or upgrade from the same or different vendor.

Ranges to values

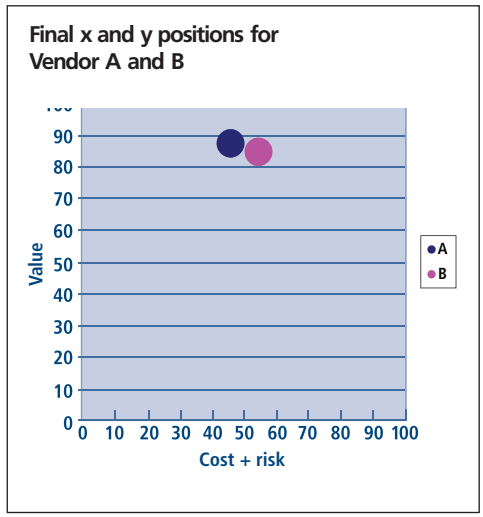
One of the other variables within this matrix is the size of the dot representing the intersection of Value and Risk scores. In other words, the risk may not be fully quantifiable to a unique real number. It may best manifest as a range of scores.

For instance, an upgrade to the HMI may have a risk score between 40 and 50 because the actual risk is hard to quantify precisely. The change matrix can accommodate this uncertainty by using the range of values as parameters for the dot on the matrix.

Say an HMI upgrade from vendor A is a standard product (not one-of-a-kind custom solution), so the X-axis value can be precisely determined to be 45. However, the members of the committee (set up to evaluate the features of the new HMI) disagree on the value and weighting of certain features. The score is a range between 45 and 55 on the Y-axis.

Further, say vendor B has a similar imprecise score for the Y-axis. The X-axis score is set to 45, and the Y-axis score between 45 and 55. The thickness of the points in this comparison figure is important so one can easily see them and make comparison.

In order to evaluate two competing migration solutions, the change matrix graphically depicts the differences in terms of ROI. Other factors can add into and work for an accurate ROI calculation including the Total Cost of Ownership (TCO) of the systems.



The TCO can be a part of the cost calculation within the change matrix.

This tool can show the incumbent vendor does not always have the highest ROI solution when it comes to a control system migration.

It also forces a more robust evaluation of ROI between competing migration solutions and helps justify a migration decision based on sound business criteria.

ABOUT THE AUTHORS

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