

Calculating the Total Cost of Ownership for X-ray Inspection Equipment



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1 Insight and Outlook

- Investments are the building blocks of a company's future.
- Planning and implementing them requires strategy and systems.
- Decision-makers who know their goals and carry out the implementation according to plan are more successful than those who rely exclusively on their impulses.
- Meaningful information forms the basis of a good investment decision.
- It helps to protect the future prosperity of your company.

Investments
are vital.
Decisions
are needed

On this basis, a process of assessing the total cost of ownership (TCO) was developed over 20 years ago in the United States, and has since been used by many companies. Considering TCO helps to better understand the costs over and above the purchase price and also – when suppliers have differing offers – to compare them and ultimately to substantiate the investment decision. What is critical here is that the method is oriented in each case to the circumstances of the industry and the company. This also applies to the field of product inspection equipment.

This white paper helps answer the following questions:

- Have you clarified the foundations of your investment decisions?
- Are you familiar with the advantages of a TCO assessment?
- Do you know what costs are critical for dynamic product inspection equipment?
- Do you know what savings you can accrue as a result of specifying the correct x-ray inspection equipment?
- Have you ever calculated the "return on investment" (ROI) time of an investment?
- Does your supplier support you?

2 Clarify principles

Any investment requires basic principles. In the food and pharmaceutical industries x-ray inspection systems have gained acceptance as effective components in quality assurance. However, their installation and the associated investment do not automatically guarantee better quality products. A clear understanding of the operating targets and requirements makes a vital contribution to this. Closely connected to this is the knowledge obtained through the TCO assessment; that is the total cost of ownership over the service life of the investment, and the expectations for the income from the investment.

Consider your operating goals

The operating goals should be clearly defined before introducing a product inspection program. They form the basis for additional steps, such as clearly formulated enquiries to potential suppliers.

Possible goals:

- Introduction of a new system
- Improvement of production time by "x" percent to improve brand protection
- Comply with national, international and/or global standards - Global Food Safety Initiative (GFSI)
- 100% of the products are to be inspected in future (one hundred percent check)
- Reduction of the waste rate due to over/underfilling of "x" percent
- Reduction of false rejects by "x" percent (incorrectly rejected good products)
- Reduction of the quality assurance costs by "x" percent
- Increasing the on line performance (accuracy and/or sensitivity)

Note: What is critical here is that each target can be measured with the aid of traceable data. And that each goal can be presented in terms of its financial implications for your company.

3 Numbers count

Make sure that the calculation is correct. Decision-makers are expected to track investments and estimate them precisely. The acquisition costs here are usually not a problem and planning them within the context of an investment decision is easy. However, anyone who wants to include the critical costs for the entire course of usage in their considerations must dig deeper and proceed systematically. Cost components emerge here that can easily exceed the purchase price. Machines must be maintained, supplied with power or additional materials, and employees must be trained – and this is over a machine lifetime which can easily exceed a decade.

Total ownership costs assessment – a solid, meaningful business model

If possible, all the costs connected with the new purchase should be taken into account. Whether large corporations or individual entrepreneurs, anyone who wants to assess an investment properly should estimate **all** the costs incurred. By considering the TCO, a calculation process is available that can help companies in precisely this area. This procedure, which was originally developed for the IT sector, has in the interim been taken up in all industry branches and lists all the relevant costs of an investment – from the purchasing process through to disposal. The principle is really very simple.

TCO assessment as the basis for management and project decisions

An investment that is made for a department within the company can have an effect on quite different parts of the company. Frequently, investment decisions compete with other financial priorities, and other projects must therefore be postponed. Not infrequently conflicts arise between business management and project management. Accurate budgeting – thanks to consideration of the TCO – over the entire service life of an investment can make it very clear, particularly to senior management, which financial expectations the investment satisfies. It often makes it easier to come to a decision and prevents conflicts between departments.

TCO assessment as a protection against "unwelcome surprises"

The selection process demands high cost transparency. One reason for introducing TCO assessments was to create a better basis for choosing a supplier. An investment commitment that is based exclusively on a good purchase price can turn out to be a fatal money-pit over the course of time. Hidden costs, which can only be recognised in ongoing operation, can turn a bargain into a financial nightmare. If the design makes modifications difficult and costly, or if frequent maintenance intervals require frequent stoppages, the costs can really shoot up. With TCO assessments, hidden cost drivers can often make the difference even before reaching an investment decision. Anyone who takes into account all the costs of an investment will make provision for unwelcome surprises and will protect against them.

4 Individuality is crucial

Industries and companies are distinguished from each other in many ways, but one rule applies to them all: a solid business model should be created before making an investment. The TCO calculation supplies properly-grounded evidence for the total cost of ownership for management and decision-makers. It is appropriate here to take into account the particular circumstances of each industrial sector and company.

TCO – tailored to product inspection technology

It is vital in the TCO consideration to highlight the savings that result from an investment, as well as the various costs connected with the system and process. Only such a procedure leads to an accurate overview of the total cost of ownership and thus to a clear assessment of the return on investment time.

5 Check the costs

TCO throws light on the costs of an investment over the entire lifecycle. This means that all expenses that are connected directly or indirectly with the investment are added into the calculation.

Direct costs

Direct costs are normally easy to determine. They are the follow-up costs that can be directly attributed to an investment. Direct costs include, for example:

- The procurement costs
- The costs of software updates
- The costs for the operation of a machine (electric energy, compressed air, etc.)
- The costs for wear and tear parts
- The costs for training
- The costs for service contracts and for maintenance and calibration

Indirect costs

Unfortunately, indirect costs are rather more difficult to determine in operative practice. They cannot be attributed exactly to one investment, and usually arise if the productivity is impeded in connection with the investment. Examples can make this clear:

- Failure times originate due to lack of maintenance, repairs and the like, and the system is not available
- Incorrect machine settings lead to poor performance or production stops
- When faults occur, colleagues are brought in from other departments in order to resolve the problem

Numbers tell us much, but not everything

A consideration of the TCO assessment offers a very good basis when a decision must be made in favour of an investment, and therefore also of a supplier. It is based on quantifiable factors and values. It must not, however, be forgotten that other, more subtle factors that cannot be expressed in monetary units may also play a role in coming to a decision. This includes some very important points, such as the reputation of an equipment supplier, as well as his pre-emptive service offerings, the quality of service and the availability of consumable and spare parts, even after a good number of years. A favourable purchase price is not much use if, later, a company is left to deal with problems alone

Note: As it is often difficult to quantify the indirect costs, estimates should be used where a calculated value is not available. It is however very important that these costs are taken into account. Identifying these costs may even show areas where other improvements within the company can be made to reduce them.

6 It's the years that make the difference

Take a close look at the TCO analysis: the first 12 months and the subsequent years are critical. The TCO calculation in the product inspection equipment field distinguishes between the costs of the initial investment (the first year) and the costs in the subsequent years. The first year after the purchase is, naturally, the most cost-intensive. The purchase price, the installation, the required training, spare parts packages and integration into the production line have a significant impact here. In some cases, external consulting costs or the disposal of old devices also come into play.

The subsequent years have their own cost aspects. In addition to operating and maintenance costs, unplanned downtimes and costly guarantee/warranty extensions take their financial toll. If official verification certification is required, the costs for conformity assessments and official tests need to be taken into account. And it should not be forgotten that the service life of a machine can now be ten years or even longer.

Costs due to the implementation of a product inspection program

A view of the costs of the initial investment. It's important to consider the following:

- **Purchase price:** The quotations from the various manufacturers who were invited to bid provide a basis.
- **Installation/commissioning (initial operation):** The relevant quotations indicate the external costs for support by service providers, consultants or fitters. Internal costs are determined through in-house hourly rates or charge rates. The critical figure is the total time required starting from the stoppage of the production line for the purpose of installation i.e. integration of the equipment solution through to the resumption of production.
- **Validation documents:** Costs for validation and certification (e.g. according to the Global Food Standard (GFS)) can be supplied by the manufacturer concerned.
- **Costs for official verifications:** A good supplier will indicate all the costs for necessary official verifications, from support through to official testing.
- **Training with the supplier or on-site with the system:** As training is offered directly by the equipment supplier, the costs are clearly quantifiable.
- **Purchasing costs for spare parts:** Any serious supplier can make appropriate statements regarding spare parts that may be required in the first and subsequent years.
- **Service offerings:** A number of suppliers offer service agreements that include various services, such as inspections, maintenance visits and spare parts. It's important also to check the various offers for service reaction time, inclusive services, price discounts for spare parts and remote diagnostics options. Remote diagnostics/remote maintenance reduces costs as aberrations can be detected earlier. As a result, any intervention by technicians can be prepared for, allowing problems to be rectified more quickly.

Note: Important items in service agreements to which you should pay particular attention include:

- Does the agreement include all the necessary visits and services?
- Does the agreement include a single lump-sum payment (regardless of how much service work becomes necessary)?
- Does the agreement also include the cost of spare parts? Does this extend to wear and tear parts?
- Does the agreement also include all travel costs and the technicians' hourly rates?

- **Integration into the production line:** The expense of integration can vary according to the situation. Is the equipment being introduced for the first time or is existing equipment being replaced or expanded? Producers are helpful here, within the parameters of their capability, and will highlight potential for optimisation.
- **Disposal of the old equipment:** On request, a supplier can take responsibility and provide a firm price.

A view of the costs of subsequent years. It's important to consider the following:

- **Operating costs:** The cost of energy and additional materials may vary widely. The supplier should have the corresponding technical information to hand.
- **Maintenance costs:** The supplier can specify maintenance intervals and expenditures. A serious supplier should be able to quote average values related to repairs.
- **Unplanned downtimes:** An overview of the past and the calculations that were previously made is the most helpful guide here. These costs can in many cases be the single biggest costs incurred by the user, especially when the line cannot run without the inspection equipment on line and functioning to specification.
- **Guarantee/warranty extension:** The supplier will provide the corresponding quotations and prices.
- **Software/hardware updates:** The supplier will provide information about frequency and costs.
- **Personnel costs:** Time required for the creation/setup of new products and switching of product setups (changeover). There are big differences between the solutions of various suppliers here. Make an estimate of how often a completely new product needs to be set up on your production line or the product setup has to be changed over.

Note: Normally every supplier is convinced that his system is the fastest and easiest to set up. You will do better to have them show you exactly which working steps are necessary, and then make up your own mind whether the operation is time consuming and needs a lot of personnel input, or whether instead it saves time and costs.

Enter your values:

Overview of the costs of a typical installation							
C O S T S	Costs of initial investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
	Purchase price		-	-	-	-	-
	Installation/commissioning		-	-	-	-	-
	Validation documents		-	-	-	-	-
	Official verification costs (if applicable)		-	-	-	-	-
	Training with the supplier or with the customer		-	-	-	-	-
	Procurement costs for spare parts packages		-	-	-	-	-
	Service contract		-	-	-	-	-
	Integration into the production line		-	-	-	-	-
	Disposal of the old equipment		-	-	-	-	-
	Other		-	-	-	-	-
			-	-	-	-	-
			-	-	-	-	-
Total		-	-	-	-	-	

C O S T S	Subsequent years (generally up to 5 years)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
	Operating costs	-					
	Maintenance costs	-					
	Unplanned downtimes	-					
	Guarantee/warranty extension	-					
	Official verification costs (if applicable)	-					
	Software/hardware updates and support	-					
	Personnel costs	-					
	Service contract	-					
	Mandatory schedule user performance testing costs	-					
	Other	-					
		-					
		-					
Total	-						

7 Take advantage of the potential savings

Compare the cost analysis with the possible savings. Whenever we make an investment, the cost is always the main focus for management and decision-makers. But the consideration of savings, in particular over the entire lifetime of a machine, can be decisive for an investment in a new system. It is therefore worthwhile including the varying savings potentials and allowing them to influence the TCO calculation.

How Can X-ray Save You Money?

Prevention of Product Recalls

The retrieval costs of product that has been despatched and the costs of dealing with customers affected by a product recall can be colossal. But most damaging could be the cost of brand damage and the decline in sales as a result of a product recall.

Evidence demonstrates that manufacturers' greatest asset, their brand, may never recover. Research conducted in 2007 by Harris Interactive has shown that 21% of people would avoid purchasing any product associated with a recalled brand, while 15% would never buy the recalled brand again. So, when thinking about purchase costs, it's worth bearing in mind that a product recall, and the costs of a damaged reputation leading to loss of consumer confidence, could easily dwarf the costs of the equipment that would have prevented it.

Automatic Data Collection

An x-ray system can eliminate labour costs in manually downloading information from the machine. Automatic collection and synchronised storage means that product statistics and data can be easily accessed and tailored reports easily compiled.

Automatic Image Saving

All images can be stored with a date and time setup and sent to a central PC, eliminating labour costs and allowing full traceability and very easy retrieval when required.

Automatic Machine Events Tagging and OPC-OMAC Open Connectivity Compliance

Every event can be tagged with an event code and time of occurrence. This can be sent automatically to any software platform to allow for automatic calculation of OEE, reducing labour costs and providing highly accurate data.

Image-Based Inspection

Since the inspection is image-based and the machine knows the exact location of the leading edge of a pack, the reject timing is extremely accurate, offering a high level of guarantee that a defect pack will be accurately rejected.

This also means that there is no requirement to test the same sample pack three separate times with a test card placed front, middle and end of pack, reducing testing times and labour, as well as increasing productivity.

Absorption-Based Inspection

X-ray systems can see ferrous, non-ferrous and stainless steel metals with equal clarity (as they have similar densities) therefore only one test card (usually a stainless steel sphere) is required to test for these metals, reducing labour for testing time and increasing uptime.

On-board Diagnostics

All electronics are monitored and the system will issue a pre-warning that there could be a future potential problem. This allows planned maintenance, increases uptime and reduces potential line stops.

More than just Contamination Inspection

As well as detecting foreign bodies, an x-ray system can simultaneously measure the mass of a pack, check fill levels, check for missing components, and check seal integrity.

Seven points that should not be forgotten

During the implementation of a product inspection programme, savings can be achieved by:

1. Reduction of scrap

Accurate and reliable product inspection equipment ensures the implementation of statutory regulations and thereby prevents expensive scrap. The financial benefit can be estimated by comparing the "before" and "after" rates.

2. Reduction of rework

Additional work that results from rejected products can be calculated from the additional personnel costs.

3. Reduction in the cost of working time

The supplier provides information on the time for product setup/changeover (refitting) and on cleaning times.

4. Reduction of "wasted" material

The costs for overfills in production can be calculated based on the sample calculation (see p. 6).

5. Prevention of product returns

Modern product inspection programs inspect 100 percent of the products produced. Deviations that run contrary to official regulations or industry standards are detected as early as possible and avoided. Potential savings are calculated by comparison with previous production and cost of product returns.

6. Protection of the brand and customer relations

Non-material values such as brand and consumer loyalty can be difficult to estimate. However, they form the basis for reinforcing the repeat sale attitude and attracting new customers. Quality is what counts here.

7. Reduction of the expense involved in audits e.g. for International Food Standard (IFC) and - British Retail Consortium (BRC) and others

The preparation of equipment tests and audits and their subsequent documentation can be time consuming and costly. Ask your suppliers for a documentation scheme that records all the relevant tests and audits, and keeps this documentation up to date. In this way you can document at any time the proper operation and use of your equipment, both internally and for the requirements of external auditors – very easily.

Enter your values:

Overview of the possible savings							
S A V I N G S	Savings	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
	Reduction of waste						
	Reduction of rework						
	Reduction of work required						
	Reduction of product "giveaway"						
	Avoidance of returns						
	Protection of brand reputation and customer relationship						
	Reduction of expense involved in audits						
	Reduction in lost downtime						
	Reduction in the costs of mandatory testing						
	Other						
Total							

8 What you Really Want to Know: the ROI Time

The TCO model, with its cost and savings values, provides a very good basis for an investment decision. In addition, it supplies the financial basis for the ROI calculation. When has the machine paid for itself?

Comparing the costs to the savings allows the ROI period to be calculated. This is reached as soon as there is a balance between cumulative savings and costs for the total investment. The values you have entered for the cost and the potential savings serve as the basis for your calculation.

In the forms you have itemised the crucial costs: from the purchase costs of which equipment, x-ray inspection system, the installation and training costs, as well as maintenance and service costs, through to all the other additional costs. These are set against the savings that can be achieved as a result of the narrower tolerances, through which overfilling and waste are reduced. The length of time required to achieve the ROI is calculated from the relationship.

The calculation is usually done nowadays using special software tools that automatically perform the calculation on the basis of your values. A good supplier will gladly make such a tool available.

ROI requires – **sometimes very little** – time

Note: Most systems pay for themselves within a few years, months or even weeks

9 Ask for Support - A Serious Producer Does not Leave you Alone

Use the knowledge and the experience of your partners. In the course of carrying out a TCO calculation and considering the potential savings resulting from the investment, a wide range of data and figures that are relevant to the useful life – from purchasing to disposal – is required. Serious suppliers therefore represent an important source of the information for the values that will be entered into the calculation. Suppliers of machines and equipment should be willing to help you and to provide the relevant information. In particular this includes indications of operating and maintenance costs and of unplanned downtimes. In addition, active support at the investment planning stage can be an important criterion when selecting the supplier.

The following is important for supplier selection:

Only partners who think for and with you are good partners!

Further Information about X-ray Inspection

FREE Technical Guide

Make an informed decision

METTLER TOLEDO has published an authoritative product inspection guide for x-ray inspection systems.

The 73 page guide enables you to select the right x-ray inspection system for your production line. It supports you to install an all-encompassing product inspection programme and to achieve compliance with standards, regulations and legislation.

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How Safe is X-ray Inspection of Food?

Some of the most popular misconceptions about x-ray inspection of food are tackled in this white paper. It is an indispensable white paper for food manufacturers who consider x-ray inspection to comply with food-safety regulations and legislations.



X-ray Inspection More Than Just Contamination Detection

This white paper explains that x-ray inspection is no longer just a technique for catching foreign bodies; it's become a wide-ranging tool for defending brand values and keeping customers happy.



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