# PISA – A tool for determining replacement values

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*PISA stands for Property Insurance Sums Insured Appraisal and is the proprietary name of a PC-based tool developed by Swiss Re for calculating replacement values for buildings and contents in selected types of business in the European economic area.*

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## 1. Full-value insurance

### *1.1 The importance of the sum insured*

The sum insured is one of the most important parameters in property insurance and serves a number of functions. It is the limit of indemnity in the event of a claim and at the same time the basis for calculation of the premium. However, it also serves as an indicator of the density of insurance cover. In full-value insurance, the sum insured must always be the same as the value of the property insured. As a general principle: irrespective of the design and terms of the individual policy, it is always the policyholder's responsibility to specify the sum insured.

If the sum insured is less than the actual value of the property, the risk is under-insured, and in the event of a claim the indemnity payable by the insurer will be reduced in proportion to the degree of under-insurance. In practice, however, especially in the case of minor claims, the insurer may, for cost reasons, waive his right to check whether the risk was under-insured. In such cases, the indemnity is paid in full, although the insurer may have collected much less premium than he was actually entitled to charge. This is also the case if, as is common practice in property insurance, policies are concluded that include a so-called "waiver-of-average" clause, where-

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by the insurer agrees not to reduce his indemnity on the grounds of under-insurance if a given loss does not exceed a certain percentage of the total sum insured or a certain absolute amount.

However, the sum insured is also used as the basis for calculating the maximum loss potential (MPL, PML, EML, etc) and the associated NatCat exposure – data which the insurer needs to determine how much reinsurance cover he himself needs. If the sums insured under the underlying property policies are set too low, there will be gaps in this reinsurance cover, with potentially serious consequences for the ceding insurer.

### *1.2 Problems in the underwriting process*

In the underwriting process, it is hard to tell whether the sum insured quoted by the policyholder or broker is the real value of the risk to be insured. This appraisal is all the more important, the higher the value of the risk. On a property policy with a total sum insured of EUR 1bn and assuming a premium rate of 0.5‰, failure to recognise that the sum insured has been under-estimated by 20% can cost the insurer EUR 100 000 in lost premium income.

The specified sum insured will be all the more credible if it is based on a sound value appraisal. However, the crucial question is what constitutes a sound value appraisal and which cost factors it must take into account.

## 2. Value appraisal

### *2.1 Cost factors relating to the specific plant*

A value appraisal is frequently equated with a survey in the real-estate context where it is limited to identifying the cost factors immediately associated with the building only (structural fabric, façades, roof structure, etc). In actual fact, the overall value of a risk is the sum of three cost parameters: buildings, technical equipment and goods.

In addition to conventional surveying to determine the value of the buildings, it is also important to take into account the technical installations and the details of the processes involved in the specific type of business, as these are key considerations determining the quality of the appraisal. This is particularly true in the case of businesses where, by contrast for instance with hotels or office buildings, the insurable values on site are governed not so much by the value of the buildings as by the cost of replacing the technical installations, such as in the case of steelworks or power plants.

Any comparison between different types of business must take into account that each branch of industry and each type of site occupancy call for a specific approach to identifying and calculating the values present. For example, in a power plant the cost parameters associated with the turbine play a dominant role, whereas in the hospital sector such factors would be practically negligible. Similarly, the cost factors represented by the blast furnace installations in a steelworks are of no interest in an appraisal of a business in the paper industry.

### *2.2 Cost factors relating to specific countries*

Value appraisals are a particular challenge when the site to be appraised is not in the underwriter's domestic economic environment, so that international economic data have to be taken into consideration.

In these days of increasing globalisation, many multinational corporations have international insurance programmes providing cover for subsidiaries or production facilities in other countries, for which value appraisals likewise have to be performed. In this context it is important to remember that the less developed a country's domestic economy is, the

more it needs to import costly equipment, machinery and expert know-how.

In order to achieve reliable results when appraising a business located in another economic area with different background conditions, it is essential to make allowance for country-specific indicators from the economic area concerned. In addition to country-specific macro-economic factors such as inflation and currency exchange rates, it is also important to pay attention to market-economy indicators such as the construction cost index, the machinery cost index or the labour cost index. In this context, analysing the construction cost index may be the least of the problems; it can be much more difficult, for example, to analyse the actual cost of labour if allowance has to be made for productivity and for the socio-political environment of the local labour market.

Such analyses become particularly complicated if only a part of the investment for a given industrial installation is subject to local market conditions and the value appraisal has to factor in EU25 index values or world-market prices for other parts of the plant. To give an example from the power plant sector, there are only a few companies anywhere in the world that have the competence and the capabilities to meet the complex requirements involved in the engineering and construction of turbine-generator units. As a rule, turbines and generators are fabricated and fully pre-assembled at the manufacturer's works before being shipped to their destination as complete units that only have to be connected up on site. As a result, the investment cost of a turbine-generator unit depends mainly on the situation in the international power plant construction market and is hardly affected at all by local payroll cost trends at the installation site. By contrast, the boiler plant of a power plant is normally installed by local labour, so that local payroll cost trends have a much greater influence on the investment cost of this part of the plant, and thus on the value of the power plant as a whole, than on the cost of the turbine-generator unit.

### 2.3 Updating of values

A material aspect with regard to the validation (and thus to the quality and accuracy) of value appraisals is the timeliness of the calculations, that is to say how close the underlying statistics were to the actual values in terms of time and how much time has elapsed since the value appraisal was performed.

If the market-economy indicators such as construction cost index, machinery cost index or labour cost index are tracked for any length of time, they can be expected to change and diverge from their baseline values at the start of the observation period. As long as the location of the business to be appraised is in an EU member country, the discrepancies may be only moderate. However, if the key indicators from resurgent markets such as Russia, where the economy is practically exploding, are compared with those from more or less saturated markets such as Germany, where growth rates are rather modest, it is clear that the latter tend to exhibit low year-on-year price rises. In the growth markets, by contrast, some sectors of the economy are experiencing dramatic price increases of 20% per annum and more, so that investment costs can be expected to double (100% growth) over a period of only 4–5 years.

This makes it essential to update the value appraisal at regular intervals in line with the growth rate in the market concerned. Of course, this principle applies especially to the statistical baseline indicators on which the value appraisal is founded. If the growth-related baseline data are not regularly re-aligned to rising costs in the specific local markets, value appraisals involving international comparisons produce completely distorted results and become practically worthless after only a few years.

## 2.4 Appraisal methods

### Valuation by rule of thumb

A valuation method known as the "capacity model" is quite common and is routinely used for determining the new replacement value of business assets. This method involves analysing the values present on the basis of plant-specific reference parameters that are normally limited to the capacity of the business and/or its output in units of finished product. For example, power plants are valued on the basis of the output parameter "megawatts of power generated per hour", breweries according to their output in "hectolitres of beer per year", steelworks are rated in "tons of rolled steel per annum", hospitals by the "number of patients treated per year", and hotels on the basis of the "number of beds".

This method does not usually take into account factors relating to the individual businesses, such as investment in ancillary systems, the size of specific process lines or different equipment and quality features. As a result, calculations performed using the capacity model typically yield inaccuracies and scatter bands in an order of magnitude of 20–30% (occasionally even 50% or more).

A couple of examples from the power plant sector illustrate the limitations of this method: the investment cost of a boiler plant increases disproportionately (quasi-exponentially) relative to the size and capacity of the installation, mainly as a result of more demanding safety requirements. By contrast, the investment cost of the turbine rises less than proportionately, the bigger the plant, that is to say, the relative cost of the turbine per unit of the plant-specific reference parameter becomes lower. Because the correlation between cost and plant capacity is not linear, any extrapolation inevitably involves significant departures from the actual value. Also, value appraisals often do not pay enough attention to accurately allowing for the ancillary systems present, although in some plants these may account for a considerable proportion of the overall investment cost. For instance, the investment volume for the flue gas desulphurization facilities may easily account for up to 20% of the overall cost of a modern power plant. Besides, the type of fuel used can also have a significant influence on the investment cost, without being directly related to the plant capacity. The cost of conditioning the fuel can differ by up to 15%, depending on whether hard coal or lignite is used.

The size of the individual process lines relative to the overall production capacity must also be taken into account. The overall capacity may be the output of one large production line or the sum of the outputs of several smaller production units. For example, the investment cost of two power plants with the same rated capacity of one gigawatt will differ considerably, if the overall capacity of the one plant comes from 5 x 200 MW units and in the other is generated by 2 x 500 MW units.

It is thus true to say that the method using the "capacity model" has its place, in that it gives a certain "indication" for a quick first impression of the rough magnitude of the values present. However, as it leaves out important factors that have a major bearing on cost and makes only limited allowance for plant-specific circumstances, this method is completely inadequate as a basis for assessing insurable values and inevitably harbours the danger of under-insurance.

### Commercial value appraisals

On the other hand, it is possible to commission commercial consulting organisations to perform value appraisals. These companies send teams of experts to carry out thorough and time-consuming inspections of the buildings and installations on site and present highly qualified findings with the best possible accuracy, taking into account a large number

of different parameters and numerous cost details.

Although commercial value appraisals afford distinct advantages and really do achieve the greatest possible accuracy, this approach also has a number of disadvantages. For instance, the detailed planning and the high manpower effort required for performing the inspections on site make this method impracticable for fast and low-cost value appraisals. It is by all means realistic for such a commercial value appraisal to take several months and cost several tens of thousands of euros.

It is thus evident that such a high-effort and expensive procedure can only be undertaken for really big risks. If the manpower required to carry out a value appraisal is greater than one day's fees, it is usually not economically viable to embark on such a project for small industrial facilities or SMEs. That is why value appraisals on this scale are generally conducted only on large industrial facilities such as power plants, oil refineries, petrochemical processing businesses and aluminium and steel industry companies.

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This puts the underwriter who has to rely on credible insurable values in a quandary. In his day-to-day business, he has little or no possibility of checking on whether the sums insured he has been quoted are based on a sound value appraisal or are merely the result of a rough estimate.

To help the underwriter overcome this dilemma, Swiss Re has developed a user-friendly, PC-based value appraisal tool called PISA. PISA stands for **P**roperty **I**nsurance **S**ums Insured **A**ppraisal and assists the insurer's underwriting process significantly by calculating replacement values for the buildings and contents typically present on the sites of selected types of business.

The PISA value appraisal is modular in structure and has been tailored to the various occupancies. At present, PISA calculation modules are available for power plants (power), combined heat-and-power plants (heat), steel production and rolling mills, breweries with bottling facilities, refineries and petrochemical processing, pulp and paper manufacture, hospitals, hotels and office buildings.

PISA focuses on the main cost clusters, especially in the case of industrial occupancies with complex process equipment. It logically integrates technologically related contexts and methodological analogies and consolidates them in mathematical computation models for the specific types of business. Intelligent link-ups between process-engineering paradigms and plant-specific contexts enable even users who are less familiar with the technical background to perform a qualified value appraisal.

The PISA value appraisal also takes into account the complexities associated with using economic data for specific countries by incorporating market-related indicators in the form of weighted factors into the computations.

The modular structure of the PISA value appraisal makes it possible to update individual computation modules at freely selectable intervals without having to reconcile the entire programming code with each modification made. This approach makes it much easier to adapt underlying data, and indeed it is this feature that makes it possible to perform computations on the basis of up-to-date indicators in the first place. Despite constantly shifting and independently changing (in some cases even counter-effective) economic conditions in different markets, this feature facilitates regular updating of the market-specific indicators.

Apart from making allowance for influences in specific countries and plant-specific cost factors, the PISA value appraisal also makes it

possible to update values at any time. However, as important as it may be to have access to detailed parameters, the principle of PISA has always been not to lose sight of user-friendliness. Too much attention to detail would harbour the danger of turning the tool into a complex appraisal system that could only be used by specially-trained experts, which would logically rule out broad-based application. That is why PISA has always followed the principle: as many data inputs as necessary, but as few as possible.

The first version of PISA was developed for the markets in Central and Eastern Europe and has been in use at numerous insurance companies since its introduction in 2004. In response to strong demand in Germany and Austria, a version specially tailored to these countries was developed in the spring of 2006. By now, versions of the program customised for all markets in the European economic area are available. PISA is thus not only a local application but can also be used for value appraisals in the context of international insurance programmes.