

# Low Cost Substations X Lower Cost of Equipment

(It is time to stop kidding with Earth's future)

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Keywords: #IEEE, #IEC, #CIGRÉ, #Simulations, #HighPowerTests, #Switchgear, #Switchboards, Bus-bar systems, Testing Laboratory, Internal Arcs, Overpressure, Temperature rise, Electrodynamic forces, stresses, Short time currents, EMC, Magnetic fields, Electric Fields, Substations, certification, smart system techniques, R&D, HR, research, Cognitor, Design of Testing labs, Innovations, Low-cost substations \*\*\*\*\* #IEC #CIGRÉ #cigre #simulation #highpowerlab #highpowerlab # switchgear #paineis #panels #switchboard #busbar #internalarc #temperaturerise #electridynamicforce #substaion #sergiofeitoza #R&D #magnetic #certification #qualification #lowcostsubstation #cepel #Kema #Cesi #PowerTech #Keri #subestação #subestacao #energiaeletrica #simulacao #simulação #simulações #switchgeardesign#aneel #MME #Inmetro #STL #paineis #IEC61439 #IEC62271

## 1. How to reduce the cost of substations ?

The main aspects that influence the creation of lower-cost products for substations are

- ( a ) the need of development tests
- ( b ) the capability of some key persons, in the team, to create and develop ideas
- ( c ) a reasonable expectancy that the new product will become a success in the market

Many years ago, I became involved with the "Feasibility Assessment of Energy Projects". Before doing this, I was used to do engineering calculations, research and deploying big high-power testing laboratories. After 25 years working in testing labs, I was invited to create a new area of the electrical energy research center. This area would even give support to the Brazilian Ministry of Energy in the implementation of programs to encourage the growth of renewable sources of energy and cleaner uses of non-renewable sources. This involved from the natural gas (Gas Duct Brazil-Bolivia), cleaner mineral coal uses to a big program of motivation for wind energy, biomass, and small hydropower plants. At that time, the wider use of solar energy was in the beginning. I learned that good fuels are the ones you have.

I soon realized that I needed to create a software tool that brought together economic and technological aspects and, more than that, a methodology which an engineer could understand. I was successful and later applied Decidix also to transmission and distribution projects and other investment projects outside the electricity sector. The most challenging application was, after leaving the Center, to create a transparent methodology to select, among a group of 40 innovation projects, the seven most promising to receive public resources for innovations. There is some information about the methodology in the link and sub-links <http://www.cognitor.com.br/DecidixDescription1.html>

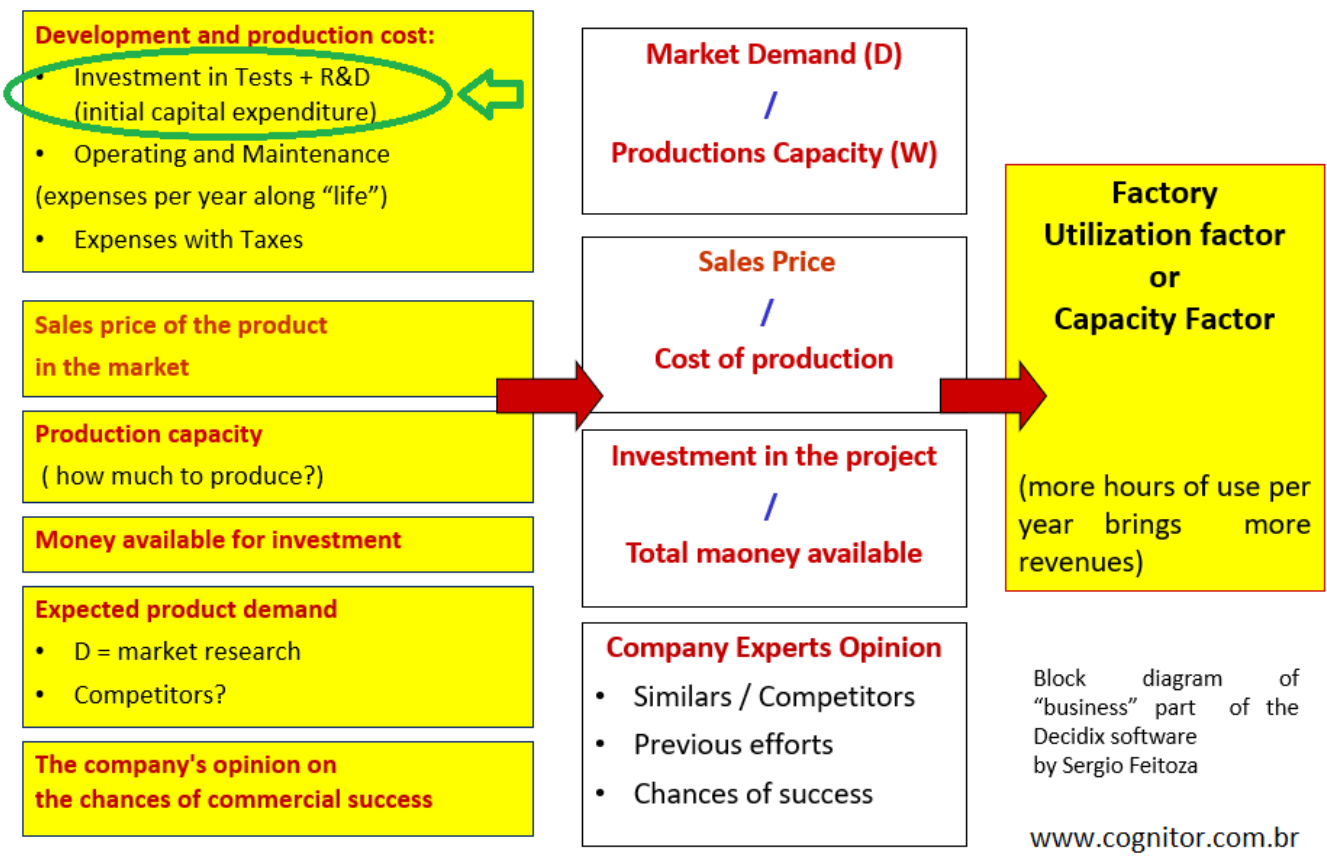
This kind of analysis involve techniques which are not of regular use by engineers and technicians. Economic issues of small and medium size power projects, like deciding to develop an innovative product for the market, are often dealt under a simplified comparison of the initial investments of design alternatives. A proper analysis should include, in the minimum, the entire project life cycle, operating & maintenance costs after the initial investment. In some cases, you may arrive to attribute values to environmental and social costs such as job creation, poverty reduction and the deforestation of large areas (I live in Brazil). These analyses are always a bit of guessing exercises and in different countries are done with different degrees of accuracy and seriousness.

In this article we discuss only about the relations between the objective of having “ Low Cost Substations” and the aspects of “ Cost of Equipment for substations”. For whom wishes to go deeper in this theme, I suggest to read the Brochure Cigrè 740 (August 2018) - Contemporary Design of Low-Cost Substations in Developing Countries. I am one of the coauthors and assure that it is the most complete in the World.

The starting point to develop an innovation for the market usually follow the sequence in Figure 1. I did this figure to define the variables to include in a specific part of Decidix. In two or three months, if I survive to the Covid19, I will publish a book on technical – economical assessment of projects in the electrical sector. It includes an overview of the technologies, environmental costs, and other things. I am reviewing the last pages and is a consolidation of materials that I used in the trainings I was used to apply .

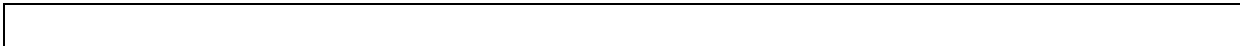
Figure 1

The starting point to develop an innovation for the market



After 25 years witnessing, in the labs, the efforts of hundreds of manufacturers developing products and, as a consultant, doing design calculations for them, I am convinced that the main barrier for (medium & small) manufacturers, for developing products, is the one marked in green . That is, “the investments in the tests and R&D steps”.

This is the part that involve higher uncertainties. To avoid that the equipment is not approved in the test the manufacturers tend to over dimension the equipment (more materials & more weight). This kills innovations. High power tests are very expensive and avoiding testing repetitions is a must. As an example, if your developing a low voltage switchboard and need to do the temperature rise test plus the short circuit tests and the internal arc tests you will pay for this (in addition to manufacturing prototypes) an order of magnitude of some USD 50.000,00 to 90.000,00. Here is the barrier.



The good news is that nowadays you can replace most of the development tests by low cost testing simulations. These ones cost less than 10% of the lab tests. A 90% savings makes the difference. However, most small, and medium manufacturers, invest little in R&D and training, and simply do not know the potential of the testing simulations.

Most of the major international manufacturers, although they have easier access to laboratories, use simulations regularly for products development. They do it before going to the final type tests in third party laboratories. To check this, you may verify who are the participants of the excellent working groups on testing simulations that work at Cigrè international. With rare exceptions they are the big manufacturers.

A key point that could be easily resolved within the IEC - International Electrotechnical Commission is the lack of a technical standard on the systematic use of test simulations to replace or reduce the cost of real tests. If you want to understand about this read article [https://www.cognitor.com.br/Article\\_Competitivity\\_Eng\\_04102011.pdf](https://www.cognitor.com.br/Article_Competitivity_Eng_04102011.pdf)

Also, at IEC, the major international manufacturers and laboratories are the majority of members of working groups acting on the preparation of technical standards. It is their merit to do this just as, in the past, they built their own testing labs that made them to go to the top.

For a new IEC standard to be created, someone must propose it. These large manufacturers and laboratories will probably not make this proposal because they still understand it as a threat to their market. This type of short-term vision prevails in the World and is what is behind the title "It is time to stop kidding with Earth's future".

I did a proposal for such standard in 2010, to the Brazilian Standards Association. The proposal had the support of 30 companies including medium and small manufacturers, testing labs and power utilities. It was not accepted. Below you may find the link for the technical standard text which was proposed.

## 2. Low Cost Substations X Lower Cost of Equipment

The only possibility to achieve the concept of "low cost substations" is through a wider use and knowledge of testing simulations to replace or to reduce the costs of high-power tests. In this beginning of June 2020, I participated in a Web Talk organized by a major manufacturer of equipment for testing labs. It was interesting, and the title was "Are simulation tools the test labs of the future?". I presented statements and questions on how to reach the concept of "low cost substations" through reaching "lower cost substations equipment".

### Statements:

- The electric industry needs to do "development tests" (to obtain a prototype – main barrier for small and medium manufacturers) and after, final "type tests" (to get the testing report used to commercialize the product). Nowadays the use of "simulations" is mainly for development tests, but some companies already accept simulations to replace test reports in cases where the common sense give openings.
- Tests are well defined in the IEC standards but simulations still do not have any IEC standard to give a guidance (see proposal I did in 2010 [http://www.cognitor.com.br/GUIDE\\_Simulations\\_v0\\_October2010.pdf](http://www.cognitor.com.br/GUIDE_Simulations_v0_October2010.pdf) but did not advance because there were no big "fathers of the idea" )
- High power tests like internal arc, short circuit and temperature rise are expensive (EUR 3000 to 15.000 per day). This is the main barrier for medium and small manufacturers
- Nowadays experts that propose and prepare IEC standards are (>90%) the big international manufacturers and the big testing laboratories. The point of view of the "user which pay the electricity bill" is not represented as it was in the past.
- Big testing laboratories will be each time less because a big lab cost some 100 million Euros and de return of the invested is much lower than other investment alternatives.
- The laboratories built in the past started from a vision of benefiting the country and not from the vision of financial investment. This no longer exists in the world.

- Small and medium laboratories are easier to implement and can be used to do some 70% of the needed tests (like temperature rise up to 25.000A, Internal arc up to 31,5 kA, short time current up to some 200kA.

#### Questions:

- Is there anyone thinking in proposing to IEC the preparation of an IEC standard for use of simulations to replace some tests ?
- Would any of the big international manufacturers or big laboratories have the initiative to propose this?
- Do you know any large or medium laboratories preparing to provide testing simulation services at the product development stage? The first one to do this will be the reference
- Is it more interesting for test equipment manufacturers to sell several small laboratories instead of to sell just one larger one?
- Is there anyone in the market selling “medium labs + simulations” ?. If so, could propose the IEC standard on testing simulations. It will become the market reference

### 3. Final words

The recent events impacting the humanity, specially the COVID19, clearly show that if we do not change immediately the logic and the paradigms of power that prevails since the Second World War, maybe we will not have a future in the Earth.

At the time of the fall of the Berlin Wall, it seemed that something was going to change to better, but it was quickly forgotten. After the time of the attack on the twin towers, instead of the countries acting to reverse violence and terrorism, through wise actions to reduce poverty and inequality, they limited themselves only to hunting and killing authors. Things only got worse from then on.

At this Covid19 event everything seems to be going to happen the same way. This can be seen even in the irresponsible attitudes of some few country presidents, exactly in the countries with bigger number of deaths. A few thousand deaths can be put on their account in support of the bad examples they set in this Covid crisis.

Seeking to reduce the cost of energy, especially in developing countries, can signalize that countries want to change the bad course. Talking about test simulations to lower energy costs is not as silly as it sounds. It can serve as a good example that we are still willing to survive as humanity. IEC and the big international manufacturers could give a good example with this. The time is each time shorter.

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#### REFERENCE PUBLICATIONS:

- Video : Testing Laboratories X Testing Simulations (30 minutes)  
<https://www.youtube.com/watch?v=qHZ1uuDYQeE&feature=youtu.be>
- Article: Small-size High Power Testing Labs & Low-Cost Substations (an idea for the new moment of the electric industry)  
<https://www.cognitor.com.br/SmallLabPlusSimulations.pdf>
- Other articles about the theme in: <https://www.cognitor.com.br/Downloads1.html>