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## **Cost-Benefit Evaluation of Installation Bus Systems and Building Automation in Housebuilding**

In housing construction, installation bus systems can be implemented in the electrical installation of application areas like lighting, venetian blinds and shutter controls, building safety, heating, ventilation as well as health surveillance (emergency systems and the installation of non-invasive medical sensors). Installation bus technology provides the possibility for these and additional functions, and many of the same components can be used for different purposes: e.g. window sensors for building security as well as for heating control management.

In the Federal Republic of Germany there are numerous examples of single-family dwellings – mostly in the upmarket range – in which the electrical installation has been carried out with installation bus technology. Moreover, property developers and prefab house manufacturers offer the technology, though still in small unit numbers since buyers often decide to dedicate their additional expenditures to furnishings of higher quality optical design.

In the course of this study no examples were found of bus technology installed in the apartments of multi-storey apartment houses. In such cases, building automation is limited to control systems for centralized facilities like central heating management or building safety.

In experimental houses – i.e. in those built not for the traditional housing market, but for the testing of future living concepts and new products – we are in the beginning stages of what today seems to be, at least somewhat, a utopian development: extensive home automation brought about through the internal and external linkage of buildings.

In order to sound out the possibilities of a wider implementation of installation bus technology and building automation in the area of house construction, this study has sought to compare the cost-benefit ratio between installation bus technology and conventional installation technology. Since existing houses due to their individuality are not suitable for a meaningful comparison, three representative model houses were developed, for which both the investment costs of a conventional installation as well as the costs of a solution with EIB (European Installation Bus) were calculated. The three model constructions are:

- a vacant single-family dwelling
- a semi-detached house (one with and one without attic improvements)
- a two-room apartment in a multi-storey apartment house.

Three different equipment standards were used as a basis (Equipment Variant 1: basic equipment; Equipment Variant 2: mid-range standard; and Equipment Variant 3: upmarket standard).

It became apparent that the bus solution implemented in Equipment Variant 1 is

more costly than the conventional installation; however, the difference in costs decreases as the functionality of the bus installation increases. For Equipment Variant 3, the installation bus system in the single-family dwelling without an attic extension is more economical than the conventional method. Here, however, the greater functionality of even the basic installation bus design – e.g. its greater flexibility – should be taken into account, although it was attempted to copy as far as possible the bus functions in a conventional way, which, however, was in a technical sense only relatively possible.

Considering the total construction costs of the model houses, the additional expense of the bus in Equipment Variant 1 (basic equipment) in the order of 0.8-1.1% of the total costs seems slight. Of greater importance are the rising costs that result from an upclassing of the equipment standard, whether such upclassing involves the installation bus or the conventional design. In the case of the multi-storey apartment building, these costs amount to 7%, for the semi-detached house they came to around 6%, and for the single-family dwelling approximately 3.5% of the total construction costs, that is, when the equipment standard was raised from Variant 1 to Variant 3.

To this extent, in respect to cost-effective building the installation of a basic bus design which allows for the options of future flexibility and later improvement is to be recommended. This is valid above all for the area of new house building, as home automation in the area of existing houses was treated only generally and without examples.