A Parameter-controlled 3-D CAD Tool for Lift Design

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ABSTRACT

Designing and modernising lift installations both call for accurate scale drawings of the shaft, showing the precise positions of all the key components and documenting the plans for different target groups. The LIFTdesigner software automates the generation of general arrangement drawings and carries out engineering calculations using the CAD data and project data, producing documentation for safety-relevant components and performing important distance, collision and safety clearance checks. During the design work 3-D component-oriented models can easily be modified by adjusting individual parameters or component characteristics as required by the project. The program is fully customisable, supporting user component definition, VBA programming interface and templates for user drawing layouts. The approach and special features of the LIFTdesigner package will be described and compared with traditional methods.

1 INTRODUCTION

The LIFTdesigner arose from lift companies' requests to reduce the production time for general arrangement drawings. During design work it is often necessary to create several drafts to identify the best solution. At this stage major building dimensions are often not yet fixed. True-to-scale drawings simplify decision making in such cases. The general arrangement drawing passes through a number of different stages from the beginning to the end of the lift project.

Most lift installations are a kind of variant on existing designs. A few different drive conceptions and their locations in the shaft repeat themselves with different component sizes and positions.

The DigiPara GmbH has for more than 10 years now dealt with variant technology in the computer aided design field. Since the end of 1996 the LIFTdesigner software application, which was developed especially for the elevator industry, has been available.

During this presentation it will become evident that the automatic preparation of drawings is only part of the functionality of this product. Due to its internal data structure it is also designed to serve as a central, highly efficient instrument for the sales order processing.

2 OBSERVED METHODS FOR PRODUCING CAD DRAWINGS

Different methods used to produce drawings will be discussed before describing the LIFTdesigner system.

2.1 Producing CAD drawings with block libraries

Where CAD has only recently been introduced there is no capability to fall back upon a stock of existing drawings to be edited. It is necessary to compile so-called parts libraries or block libraries for the components being used before productive work can begin.

Since the blocks are normally defined two-dimensionally, something like component-oriented working is possible. The parts can be inserted in the drawing with a few mouse clicks. Some manufacturers offer drawings of their components on disk in the current CAD data exchange format (DXF) to facilitate their use in a CAD system.

Pros:

- Basic CAD functions, easy to learn, easy to use.

Cons:

- Considerable time still needed.
- Maintenance of the block libraries required.
- No parametric behaviour.
- Working three-dimensionally not possible; no relationship between the different sectional views of the shaft ⇒ Risk of making mistakes !

2.2 Producing CAD drawings by copying and editing existing projects

After having used CAD for some period of time the probability grows that a similar project will have been worked out in the past. After copying an existing project, it can be edited and the drawing quickly finished.

Pro:

- Comparatively low time expenditures where project data are very similar.

Cons:

- Finding a suitable project is difficult. A high level of experience or special PDM software is required.
- No parametric behaviour.
- Working three-dimensionally not possible; no relationship between the different sectional views of the shaft ⇒ Risk of making mistakes !
- Additional risks taken by relying too much on the similarity of older projects with the present one and trusting in the correctness of the old drawing.

2.3 Producing CAD drawings with self-made macros or software

User-generated macros or software programs require high proficiency in using CAD systems. They are specially developed according to the needs of a particular product. In addition to producing drawings, they often make it possible to determine relevant data for bills of material. After all the project data has been entered by way of structured dialogs, macros take over the task of producing drawings automatically. Often there is no interactive relationship between the drawing and the macro. If changes in the lift system become necessary, all the data must be re-entered to repeat the macro.

Pros:

- Low time expenditures when producing drawings.
- Flexible solutions, very specific to the company's needs.
- Extensions to generate bills of material are available in part.

Cons:

- Great expense and long development times.
- High software maintenance expenditures.
- These projects often die when the developers assume other assignments or leave the company.

3 WORKING WITH LIFTDESIGNER

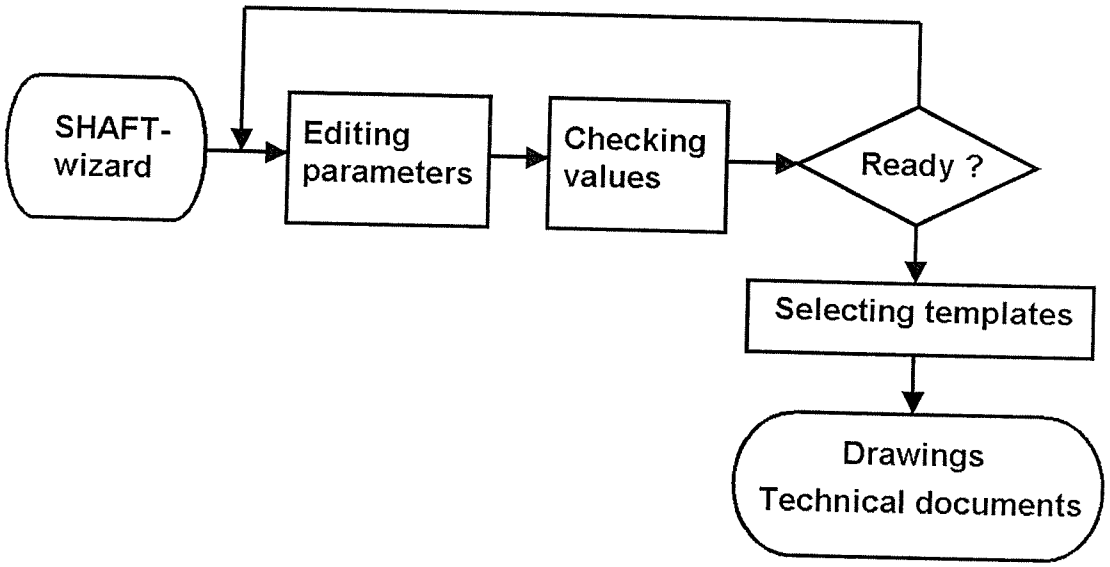


Fig. 1: Schematic processing of a LIFTdesigner project

3.1 Specifications for a new project

A special part of the software, the *SHAFTwizard*, supports and prompts the user when defining a new project. First of all he has to specify the type of lift using certain major project data. Immediately thereafter the so-called main project data dialog makes it possible to enter other important parameters for the lift.

As an alternate to *SHAFTwizard*, the open software architecture and modern programming interfaces offer the capability to use data from other applications to initialise a LIFTdesigner project. The more data supplied in this way, the greater the degree of automation for the production of drawings. Due to simple integration into existing IT structures an absolutely client-specific course is possible in this first step.

3.2 Editing lift parameters

3.2.1 Editing the lift's geometric data in the drawing

After having started the project you can edit any parameters in the installation directly in sectional views until the best solution appears.

It must be especially emphasised that you need never draw a single line. The user selects a dimension with the cursor. The value appears in a dialog which may be edited immediately. The entire drawing updates automatically, no matter whether a value has been changed in the vertical view, plan view, wall opening, or wherever.

3.2.2 Building data

There is a clearly arranged floor level list in which to enter all building structural data. You can also determine which lift of a group of lifts has entrances on which levels and on which face of the shaft.

3.2.3 Selecting components

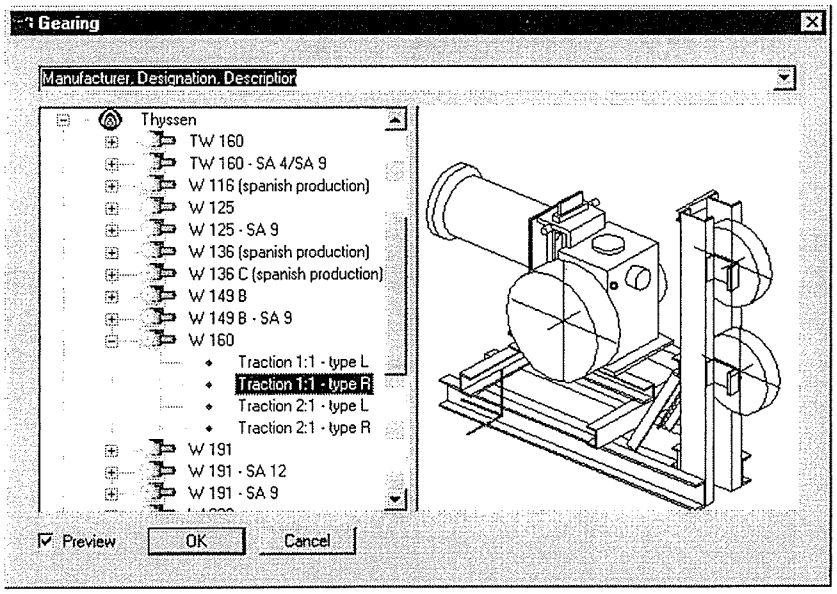


Fig. 2: Component selection

LIFTdesigner is a completely object-oriented system. Therefore all lift components can easily be edited. The user can view the properties of every component with a double mouse click.

Responding to the component selection, the data for a comprehensive range of suppliers can be provided. The three-dimensional component data guarantees correct visualisation of any component substitution in all sectional views.

3.3 Calculations during the design work

3.3.1 Technical calculations

The system can perform technical checks of safety-relevant components at the touch of a button and whenever desired. The calculation routines, of course, access all geometric data for the lift as well as all the technical data for the components selected and will deliver results immediately.

Let us take the guide rail calculation by way of example: It is not necessary to enter levers, fixing distances, car sling data, car dimensions, or guide rail properties to view the current situation for the stress on the guides.

3.3.2 Checking distances and refuge spaces

In the same way minimum distances and refuge spaces can be checked at any time, for the entire installation. An error report shows the results of all calculations for checking purposes.

3.4 Producing drawings

3.4.1 Using templates

Any desired templates, specific to the user, may be selected for direct print-out. They cause the program to automatically use drawing parameters which had previously been specified (frame and title block, location of the views etc.). The drawing is output once a template has been called.

The time required from generating a new project to printing complete scale shaft drawings may be only a matter of a few minutes.

3.4.2 Direct communications with a CAD system

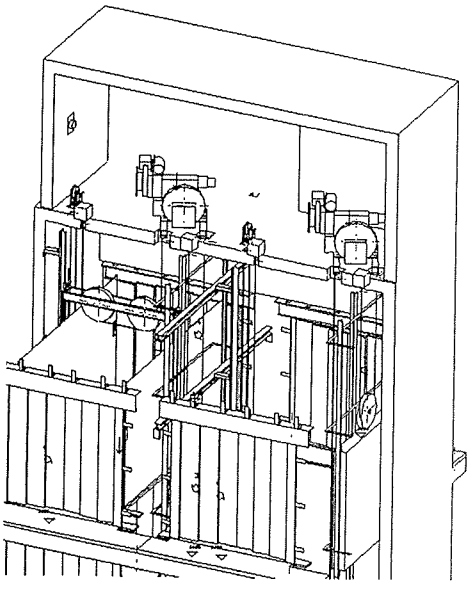
It is necessary in some cases to process the drawing further in a CAD system. The main reasons for this are the specifics of the structure, if they are to be visible in the drawing.

The RX interface at the LIFTdesigner, enabling communications with AutoCAD 2000, permits data interchange between these two systems. Similar to the sheet templates mentioned above, sections generated by LIFTdesigner will be transferred once to the AutoCAD drawing. AutoCAD can be used in the usual way to draw all the details relevant to the building structure. LIFTdesigner will automatically handle correct depiction of the elevator system within the shaft.

Even where changes to the elevator system are required in an advanced phase of the planning project (drawings having been already prepared!), the AutoCAD drawing will be updated fully automatically.

The RX interface makes a major contribution to flexibility and data security.

4 TECHNICAL SPECIFICATIONS, INTERFACES



4.1 Program structure

LIFTdesigner operates three-dimensionally throughout, an important aspect for error-free drawings. All the parameters in an elevator system can be modified in a component-oriented fashion. This application, which runs autonomously under Microsoft Windows, comprises two major components: the core program and the database. The core program dynamically generates a parametric, three-dimensional data model for an elevator system, drawing on the components contained in the database.

4.2 Interfaces

4.2.1 A company's own components and standard systems

A company's own components will mesh ideally with LIFTdesigner, provided that they are defined three-dimensionally in the database. Dependencies and interactions with other components and dimensions will be taken into account. A special technique makes it possible

to specify any desire degree of precision in storing component information; here a compromise among effort, utility and computing speed is to be aimed for.

The completion of projects can be accelerated considerably whenever standard systems can be drawn upon. Tables used to describe standard systems have been devised especially for this purpose.

4.2.2 Calculations

Any desired applications can exchange data with LIFTdesigner by way of the ActiveX/VBA interface. This makes it possible to link additional calculations, test functions etc. which are specific to a particular company.

It is technically possible to start LIFTdesigner from another application, to transfer data and to start fully automatic drawing without having to enter a single command at the LIFTdesigner interface.

4.2.3 Documents and parts lists

The LIFTdesigner project file contains all the geometric and technical information on the lift system; it can automatically be made available to every other application.

An integrated report function makes it possible to output lift data to existing forms (description of the elevator system, supporting calculations etc.) using placeholders (formats: ASCII, RTF, Microsoft Excel) or in forms which are generated dynamically (parts lists, calculations for cylinders etc.).

A link to a component database which may already be available will be set up to generate the parts list.

4.3 Example of data flow

The data flow schematic shown below describes the integration of LIFTdesigner into an existing IT environment, with pre-existing order or contract processing and component database.

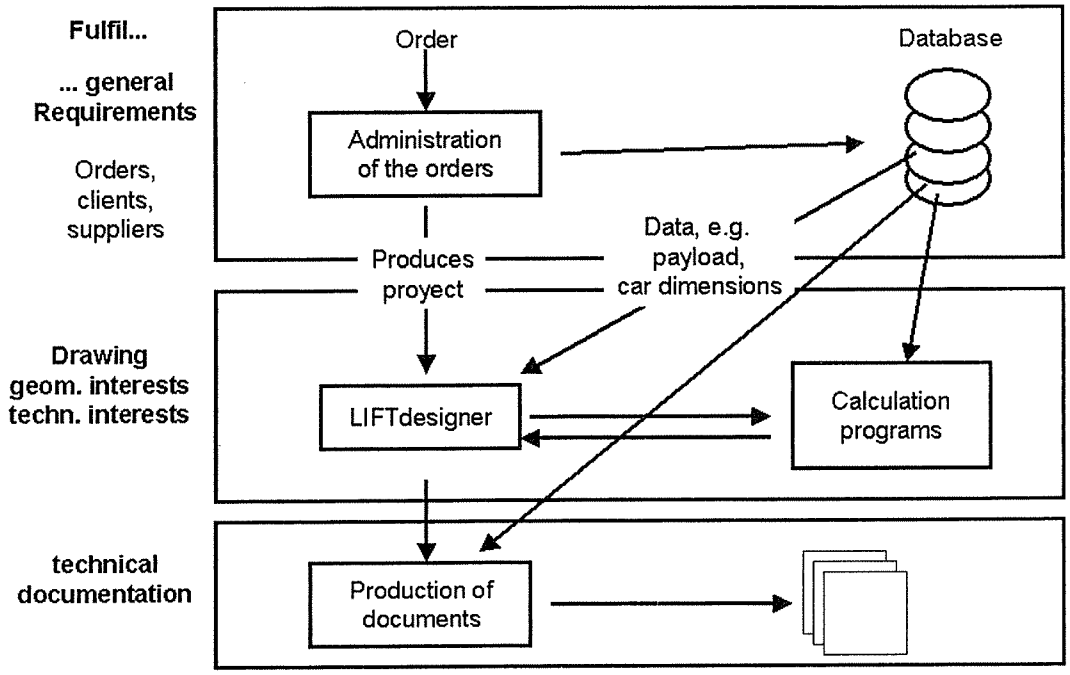


Fig. 3: Integration of LIFTdesigner into existing structures

5 OPTIMISING SALES ORDER PROCESSING

The LIFTdesigner program suite is not only to be seen as a stand-alone solution used to generate drawings. It offers major advantages when employed as a central instrument in order processing.

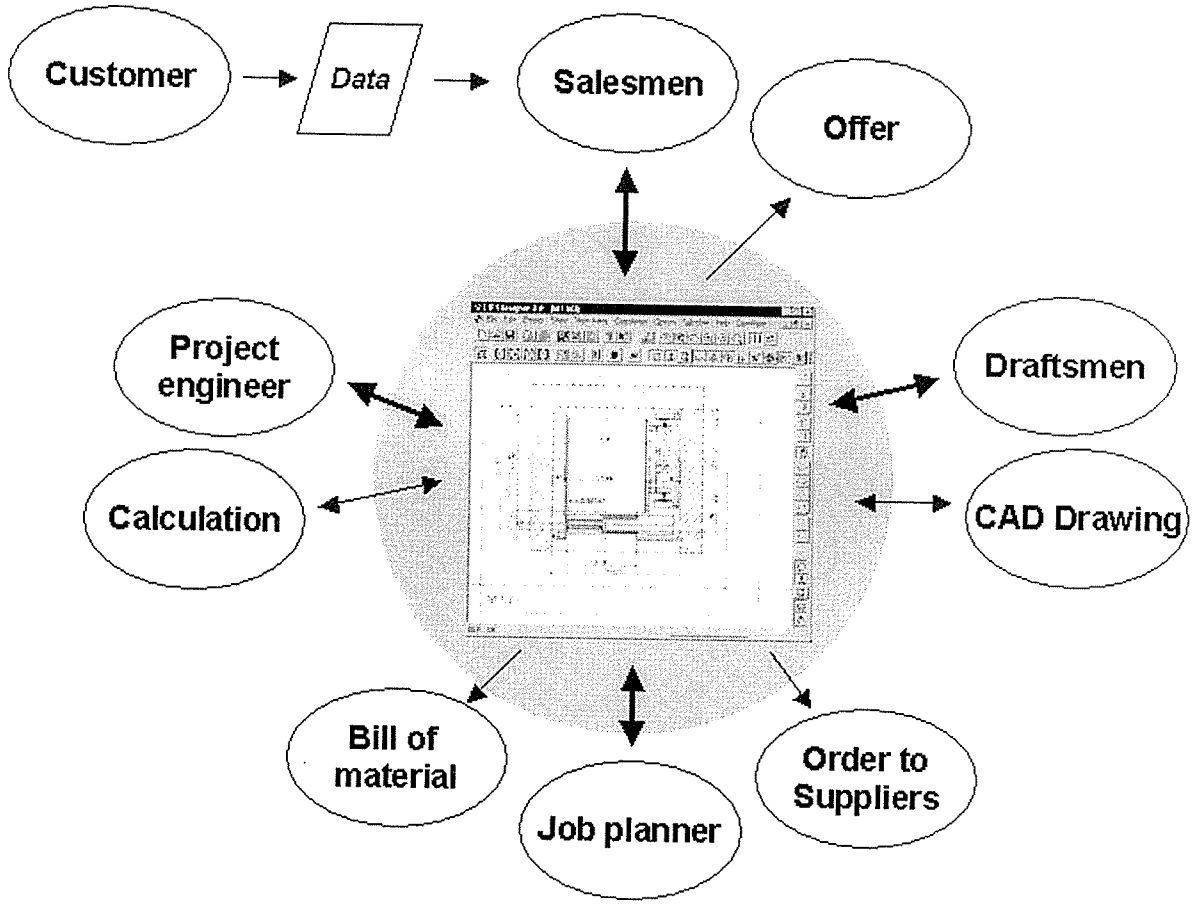


Fig. 4: LIFTdesigner as a central element in order processing

Phase 1: Sales staff, working with the customer, identifies the ideal solution to the transport assignment. All major product data will be worked out together. A price can be ascertained immediately for standard systems.

Phase 2: The technical office checks the planned project. Components will be replaced as necessary until they satisfy the specific requirements and the safety standards. The basis here is using the project file which was generated by the sales staff.

Phase 3: The technical draftsman uses the same project file to generate the system and component drawings, at a greater or lesser degree of automation, depending on the situation within the building structure.

Phase 4: The parts schedules are prepared once the order has been finalised. Depending upon the parts selected, documents can be generated for in-house manufacturing and/or to order bought-in parts.

- The common data pool ensures that no information will be lost as the project progresses. Modifications will be undertaken only at a central point.

6 CONCLUSIONS

The pressures of competition dictate ever faster throughput times, particularly in a project's early phases. Shaft and assembly drawings are often expected to be delivered just as soon as the order has become final. Scale drawings are also a convincing basis for discussion when bidding for a job. Complete parts lists and order schedules are required for internal procedures and interfacing with suppliers.

It would hardly be possible to work efficiently at all today without the use of modern information technologies. These tools offer dramatic advantages only when they are integrated into the system as a whole and are not used as stand-alone solutions.

Using 3-dimensional, fully parametric registration and planning of an elevator system throughout means major advantages when using LIFTdesigner, in all the stages of order processing:

- A project can be worked out in detail, without great expenditures in time and effort, right in the sales phase.
- The project data are archived at a single location. The risk of misinterpretation as the system passes through the various processing phases is eliminated.
- 3-D collision checks, standardised test functions and technical calculations can be called up at any time, without having to enter data again.
- Manufacturers' libraries are available.
- Sensational time savings are attained in preparing system drawings. Maximum flexibility is guaranteed with the permanent interface to AutoCAD.
- Capabilities to modify the elevator system very quickly are available at every phase in order processing.

Biographical details

Thies vom Hofe finished his study of wood and mechanical engineering with the development of a CAD application for checking wooden framework constructions. He joined DigiPara in 1993 as developer and technical salesman after a longer stay in Concepci¬n, Chile, teaching the application of CAD systems in the technical university B□o B□o. Since 1996 he is involved the lift branch of industry.