THE FUNCTION PRIORITY MATRIX
Meeting the Function of Function Analysis

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Abstract

This paper outlines a new method for performing Function Analysis which has been developed by Marcus Grönqvist, Steven Male and John Kelly and subsequently tested and refined in a series of Value Management (VM) studies. This paper will briefly summarise the background and history of Function Analysis, explain the forms most commonly in use, outline the Function Priority Matrix (FPM) method and discuss the advantages and disadvantages between FPM and other methods of Function Analysis.

Introduction

Function Analysis is widely regarded as being one of the three cornerstones of VM together with the Job Plan and the use of Multi-Disciplinary Teams. In fact, both the SAVE and European Standards on VM stipulates that Function Analysis should be used in VM studies. However, the way in which Function Analysis should be applied is only suggested, based on current methods available, and VM being a methodology for improvement and change leaves the scope open for new methods of applying Function Analysis.

However, before continuing it is appropriate to highlight that, for the purpose of this paper, VM is used as an all embracing term, including Value Engineering, Value Analysis, Value Planning and so forth.

Background and History of Function Analysis

It is generally regarded that Lawrence Miles was the inventor of Function Analysis during his time at General Electric at the height of the Second World War (Miles, 1972). Further development was carried out by Charles Bytheway who developed the Function Analysis System Technique (FAST) during 1964 and subsequently presented at the 1965 SAVE conference. Subsequently variations on the above techniques have emerged including the Function Breakdown Structure (Norton & McElligott, 1995 and Thiry, 1997) and Objectives Hierarchies (Connaughton & Green, 1996 and Green, 1997).

There are differences in their applications with some being more suited to existing products and others to problem definition and new product development. However, they all have in common the fact that they all aim to bring a greater understanding to the problem under investigation.

Common Types of Function Analysis

The most common methods of Function Analysis are outlined below, for further and more detail on how they are performed please refer to the references provided. There are, obviously, differences between the methods, however, most texts recommend that a function be expressed in as concise a phrase as possible, ideally one comprising just an active verb followed by a noun. Passive verbs include 'provide' and 'allow' whereas active verbs are, for example, protect, hold, attract, enclose, they are, in effect, more descriptive. The technique of stating function using a verb-noun helps to reduce a problem into its fundamentals. The advantages of the approach are (Dell'Isola, 1982):

- Forces conciseness. If you cannot define a function in two words, you do not have enough information or understanding about the problem, or you are trying to define too large a segment of the problem.
- Avoids combining different functions and ensures that only one function will be defined at one time.
- Facilitates the task of distinguishing between primary and secondary functions because it helps to identify each function as specifically as possible.
- Aids in achieving the broadest level of disassociation from specific designs or previous solutions.

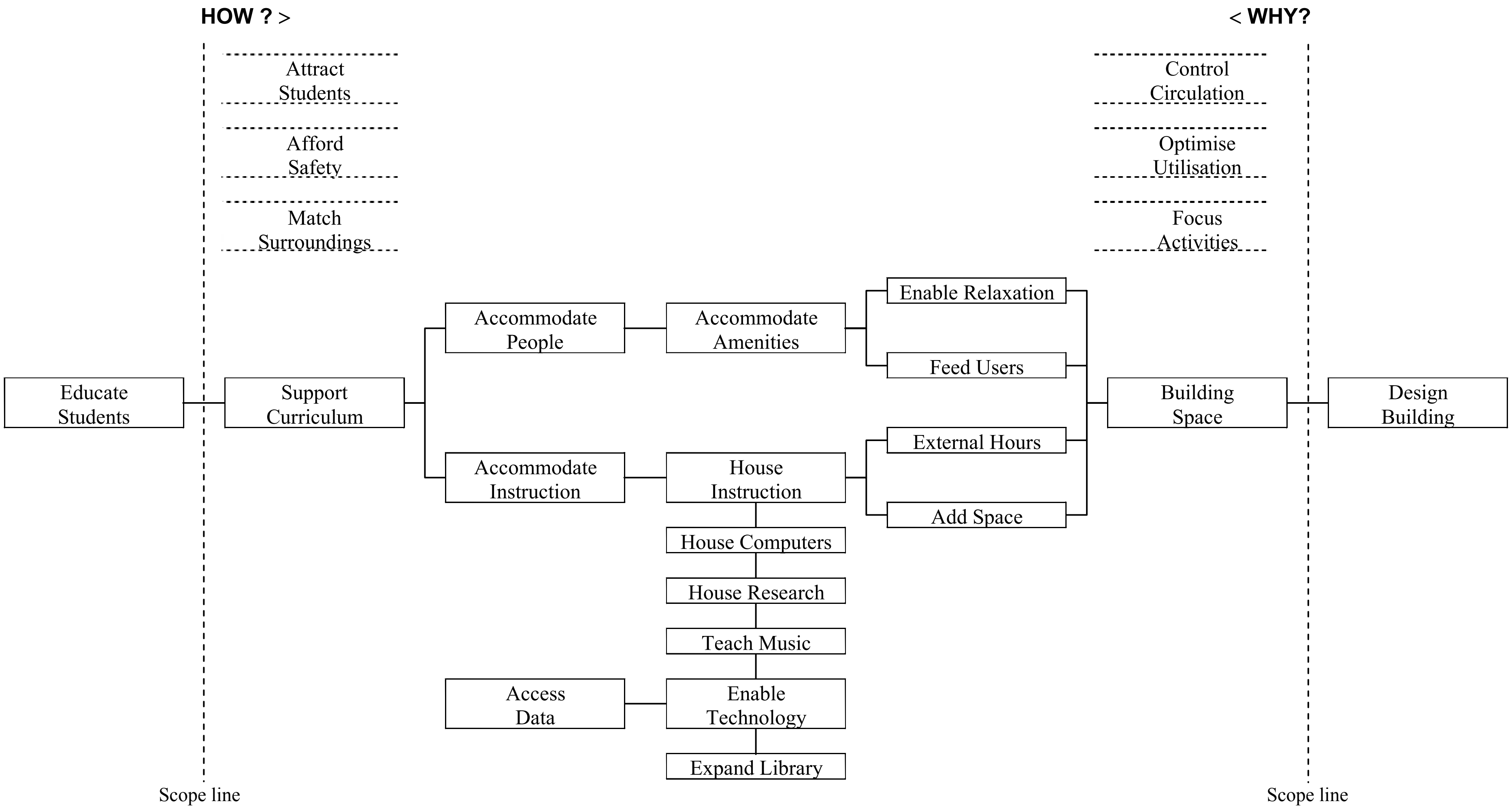
How these functions are then structured is, essentially, the differences between the methods. The four methods of Technical FAST, Task FAST, Function Breakdown Structure and Objectives Hierarchies are briefly described below.

Technical FAST

An example of a Technical FAST diagram, taken from Norton & McElligott, is outlined and illustrated below. The Technical FAST techniques follows a few basic rules (Norton & McElligott, 1995):

- *The scope of the problem being investigated is delineated by vertical lines at the left and right of the diagram.*
- *Higher order functions are placed to the left on the critical path, the highest order function which is the prime objective of the basic function is place outside the left scope line.*
- *Lower order functions are placed to the right of the critical path, the lowest order function is placed outside the right scope line. The basic function which represents the purpose of the project is placed to the immediate right of the left scope line.*
- *Design objectives, criteria or specifications which must be observed are placed above the basic function within dotted line boxes.*
- *The major critical path of functions is that which runs centrally through the diagram from left to right; those functions which lie on the critical path must exist to achieve the basic function. Other functions on the diagram may or may not have to exist to achieve the basic function and are subordinate to those on the critical path.*
- *Concurrent supporting functions that occur at the same time or result from a function on the critical path are placed directly below the corresponding function on the critical path.*
- *Continuous supporting functions are placed on the right of the diagram above the critical path.*

As the name implies the technique is well suited to depicting the technical performance requirements of a problem. It also takes into account the time element, to a degree. The How/Why method for testing the logic of the resulting diagram is used.

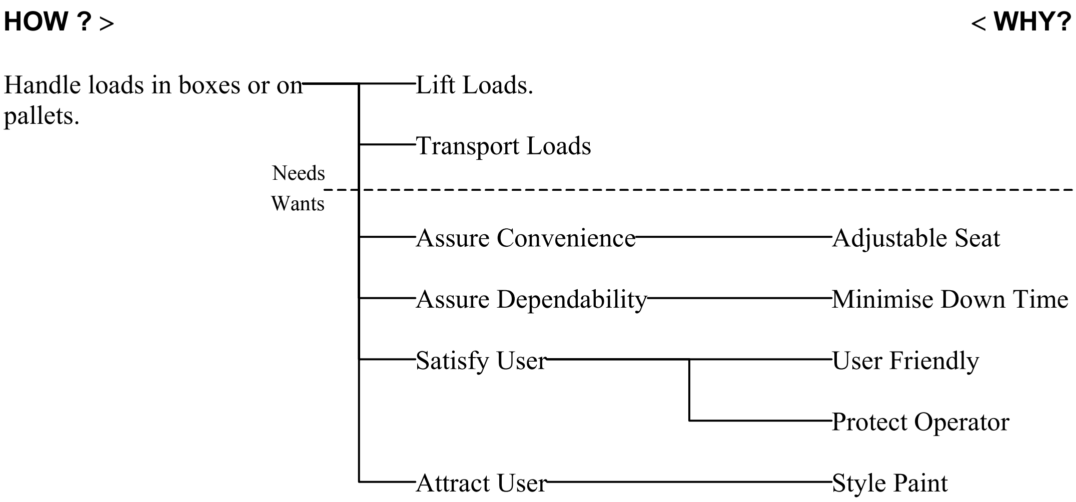


A Technical FAST diagram for a college building project (Norton & McElligott, 1995).

Task FAST

A Task FAST is described as having a primary function representing the client need and four supporting functions representing client wants, namely: Assure Convenience, Assure Dependability, Satisfy User and Attract User (Kelly & Male, 1993). In a Task FAST diagramming exercise a concept is taken and developed from left to right by asking the question 'How?' going from right to left and 'Why?' going from right to left. The example below has been developed for a fork lift truck of the type used in warehouses. The prime function is to handle loads in boxes or on pallets (Kelly & Male, 1993).

The technique is used to depict the performance requirements for both technical and also more strategic problems with the How/Why method to test the logic of the resulting diagram.

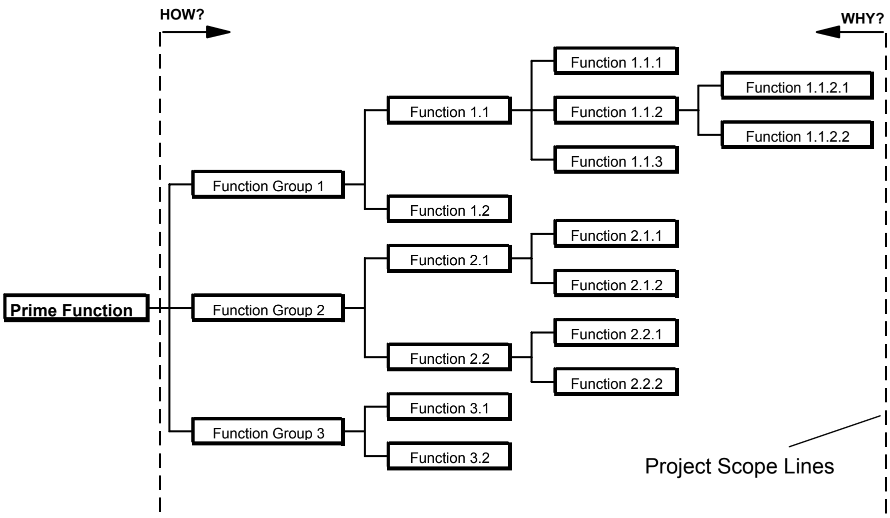


A Task FAST diagram of a fork lift truck (Kelly & Male, 1993).

Function Breakdown Structure

The Function Breakdown Structure essentially evolved from the Task FAST and mostly is destined for new products that will be developed from a need into measurable or assignable functions that will be used for design (Thiry, 1997). It does not necessarily include the customer concerns or functions of the Task FAST but is based on customer function identification.

When a suitable set of functions have been generated these may then structured into a diagram in the following manner. The How/Why method for testing the logic of the resulting diagram is used.



An example of a Function Breakdown Structure (Thiry, 1997).

Functions on the same level should be totally independent from each other and can even be contradictory.

Objectives Hierarchy

Essentially the same as a FBS, but the emphasis is on the objectives of the project, rather than the functions that it has to perform. It must be stressed that the authors do not intend to get involved in a semantic debate as to what the differences between functions and objectives are ,but refer the reader to a presentation by Roy Woodhead (Woodhead, 1998) should more information be required. Furthermore, it is common to weight the objectives in the hierarchy so as to establish their relative importance.

A brief description of an Objectives Hierarchy is given below (Connaughton & Green, 1996 and Green, 1997).

> *The top of an Objectives Hierarchy is characterised by the over-riding raison d'etre for the entire project. This is then progressively broken down into sub-objectives. Whilst the higher-order objective represents an end in itself, the lower order objectives are considered to be 'means-to-an-end'. It is important that the value tree is produced by group consensus and that each participant feels involved. Judgement is required with respect to how far the objectives should be subdivided.*
>
> *Having established the Objectives Hierarchy, the next stage is to allocate an importance weight to each of the lower-order attributes. Once again, it is important that this process is performed on the basis of consensus. The weighting can be done in various ways, but it is common to normalise each level of the hierarchy on a percentage basis ie. each group meeting at a node on the hierarchy will add up to 100.*

The technique is primarily used for setting the objectives of a problem at the strategic level. The How/Why system for testing the logic of the diagram is not used, instead the team structures the diagram according to the consensus of the group. The objectives generated by the group are not restricted to verb/nouns, but short statements are preferred.

- Accommodate Department in one Location.
  - Good Staff Accommodation 35%
    - Space per Person 30%
    - Internal Environmental Conditions 25%
    - Internal Layout 25%
    - Staff Car Parking 20%
  - Flexible for Future Change 20%
    - Accommodate Different Uses 65%
    - Provision for Future Expansion 35%
  - Good Design Impact 15%
    - Environmental Impact 40%
    - Visual Impact Externally 30%
    - Visual Impact Internally 30%
  - Efficient in Use 12%
    - Flexible for Short Term Changes 60%
    - Adequacy of Storage Space 40%
  - Accessible for Customers 10%
    - Visibility of Entrance 50%
    - Waiting Area Size 25%
    - Visitors Car Parking 25%
  - Low Maintenance Costs 8%
    - Building Maintenance & Repair 34%
    - Energy Costs 33%
    - Security, Cleaning, etc. 33%

Example of an Objectives Hierarchy with percentage weightings (H. M. Treasury, 1996).

The Function Priority Matrix

Introduction

> *"To help achieve better solutions to problems sooner, different building blocks are needed. These must cut to the heart of the basic problem and keep penetrating thinking in the heart area. This is vital, or side issues, which are apparent, will draw attention from the main issue (Miles, 1972)."*

The key to the FPM method is to meet the above statement by Lawrence Miles in a manner which expends as little effort and time as possible, in other words, minimising the cost/worth ratio and meeting the function of Function Analysis – 'Define Purpose'.

The method was developed over several months in 2000 during which the authors were heavily engaged in a number of strategic VM studies. It was borne out of a slight frustration that the methods most commonly used are quite cumbersome and time consuming which partly stems from the fact that the participants in VM studies usually encounters the method for the first time in the study that they are attending. Hence, there is a substantial learning curve for them to go through in order to understand what the method is about and how it works whilst having to perform and partake in the exercise during a 'live' situation.

The following explanation and example of the FPM method is taken from a VM study involving a library project in the UK.

The Method Explained

The following case study will illustrate the concept and working of FPM. It was successfully employed on a VM study analysing the delivery of a new library facility for a leading UK university. The FPM was utilised instead of the more traditional Function Analysis approaches as outlined above. The aim was to quickly and in a structured manner arrive at what the functions of the project were and to prioritise them in order to deliver an appropriate solution.

The FPM analysis is arrived at through the following steps:

1. Brainstorming of short statements, ideally verb-noun, answering the question: What is the function of the project?
2. Sort statements generated on a 2 x 2 matrix according to whether they are considered to be:

	Strategic The Business Project	Tactical The Physical & Technical Project
Needs	Business Needs	Operational Needs
Wants	Added Business Benefits	Embellishments

3. Prioritise the functions considered to be Strategic Needs using 'sticky dots' in order to establish the project mission.
   - Prioritisation may also be carried out on the Tactical Needs should that level of detail be required or if the analysis is tactically and technically focused.
   - Grouping 'like' functions within each of the four quadrants may take place before or after the prioritisation, if deemed necessary. Structuring the functions in the top two quadrants ie. the needs, may also be carried out, if deemed to add value to the exercise.

The method essentially follows Miles Problem-Setting System (Miles, 1972) which has the three steps outlined below:

1. Identify functions.
   - What functions do the customer need, want to accomplish and pay for?
2. Separate functions.
   - Establish the main function and divide remainder into sub-groups.
3. Group functions.
   - Group in to 'mind sized' pieces that can be solved.

The statements categorised as Strategic Needs are core to the project whereas some of the others may possibly be targeted for value management and engineering if deemed necessary. The resulting analysis is summarised below. The numbers in brackets represents the number of 'sticky dots' that the function attracted.

	Strategic	Tactical
Needs	• Support university business strategy (4). • Give competitive edge (3). • Replace inadequate existing facilities (2). • Re-orient university to be customer focused (2). • Support distance learning education (1). • Facilitate research (1). • Support business generation (1). • Preparing for future (1). • Responding to university growth (1). • Promote learning for life. • Flaunting confidence. • Reacting to customer needs. • Project university image as mature university. • Assure enhancement of market share. • Widen participation. • Increase market share. • Enable university to be leader in distance learning education. • Attract customers.	• Delivering electronic services round the clock. • Increase space. • Facilitating service. • Upgrade facility. • Maintain staff. • Managing change in technology. • Upgrade estate. • Archiving material. • Attract staff. • Point of access. • Centralise staff. • Facilitate networking. • Study centre. • Train users. • Develop curriculum. • Take advantage of new technology. • Create appropriate internal environment. • Storing books. • Maximising site potential. • Create a hub. • Create reader spaces. • Preserve material. • Accommodate offices.
Wants	• Enriching the university . • Reflect image of university . • Enriching the local community. • Raise university esteem. • Retain students. • Enhance visitor facilities. • Make image statement. • Create image. • University asset. • Maintain growth in university . • Embrace new vision. • Spend money.	• Facilitate university organisational change. • Change university working practices. • Good image. • Providing employment. • Develop site. • Enabling change in working practice. • Provide refreshments. • Point of focus. • Outsource library. • Facility for all university community.

Library Project Function Priority Matrix

Applications

The method is most suited to projects at the strategic end of the project life cycle, i.e. the inception of a project, to quickly and efficiently determine what the project is about and to reach consensus amongst the participants. The method is not restricted to construction related projects but can be applied in virtually any area both as a strategy definition tool and also as a tactical and technical clarification tool.

If it is applied at the tactical and technical level of a project, the focus of the analysis will then be on the right two quadrants of the matrix where weightings and structuring will have to be applied. Needless to say, although the focus will be on these quadrants, any tactical and technical functions identified and prioritised will have to meet the business functions identified in the top left quadrant on the matrix.

Advantages and Disadvantages of the Methods

Each method described above has its own advantages and disadvantages. A brief comparison between the methods is carried out in the following section.

Advantages

General advantages of all Function Analysis methods include:
1. Helps to structure the problem under investigation.
2. Aids in reaching a consensus between study participants, including focusing and making sure they all pull in the same direction.
3. Defines the ‘needs’ and ‘wants’ of the customer.
4. Ensures a deeper understanding of the problem or project.
5. Encourages information sharing between participants.
6. It ensures a customer focus whilst keeping objective about the problem (BRE, 2000).
7. It highlights value mismatches (Norton & McElligott, 1995).
8. Supporting the process of generating creative alternative solutions (Hayles & Graham, 2000).

Disadvantages

Some disadvantages of the traditional Function Analysis methods described above include:
1. They are usually cumbersome to structure.
   - Participants have normally not come across the technique employed before and, therefore, have to learn it in a ‘live’ situation which may cause problems.
2. They can be time consuming to construct due to semantical arguments as to how the verb-noun functions should be put together.
3. Constructing the hierarchical tree structure can take a long time due to differences of opinion between participants.
4. The skill of the facilitator is important when conducting a traditional Function Analysis.
5. Does the end product justify the time spent achieving it? Value = cost/worth?

How does the FPM Compare?

The FPM was borne out of the need to find a method that would bring out the advantages as listed above whilst minimising the disadvantages of the traditional methods. It is argued here, backed up by the experiences gained using the FPM on ‘live’ studies, that the method meets all the advantages of the traditional methods whilst at the same time bringing some additional benefits.

These additional benefits include:
1. It is an intuitive approach which requires little explanation and that the participants readily understand and sign-up to.
2. It is quick to construct, although there will be discussions and debates just as for any other Function Analysis method. However, the debates are less ‘petty’ than tend to be the case when performing a more traditional method. This is due to the fact that function statements are not restricted to verb-nouns and that sorting (2x2 matrix) and prioritisation (‘sticky dots’) is easy to understand, intuitive and visually very powerful ie. the outcome is difficult to refute.
3. The structure achieved ie. the 2x2 matrix with the needs prioritised gives the participants a sufficient descriptor of the project or problem under investigation to focus the team on the actions necessary for subsequent stages of analysis.

Conclusion

To conclude, the method outlined above is proven and has worked very well in a number of workshops conducted by the authors. It is an intuitive, structured and quick approach which the workshop participants readily understand and sign-up to.

The length of VM workshops are tending to shorten due to client demands. Clients are placing more pressure on VM facilitators to run single 1-day workshops (Hayles & Graham, 2000). Some facilitators readily accommodate the client's wishes, sometimes to the detriment of the VM process, usually by omitting Function Analysis. Other facilitators insist on longer workshop lengths, in order to be able to run through the Job Plan and conduct Function Analysis, with the result of clients sometimes pulling out due to the increase in perceived costs. However, more research is needed to try and accommodate both schools of thought and the FPM is a starting point in doing so.

Finally, VM is a very adaptive methodology and so are the methods used within the VM framework. Value Managers tend to use tools and techniques which they are comfortable with and which are suitable to the project under investigation and that should also be the case with the FPM. It is a method to be used as and when deemed appropriate by Value Managers that are comfortable with it, or with variations and improvements that they themselves have added to it. VM is all about change as well as innovation and as such the methodology and the tools used must be flexible enough to aid in managing both change and innovation.

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