

## Upgrade of console programs in the KEK E/P Linac from an expert operators' points of view

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### Abstract

Most console programs have been developed for operators by programmers, or a field expert who takes care of accelerator devices. However, we should develop a feedback of operator experiences to the console programs. We evaluated the opinions and experiences of expert operators for console programs from their points of view, which searching for suitable programs. The results of our evaluation and some problems regarding on upgrade are discussed in this paper.

### 1 Introduction

To improve the operators' console for the new J-Linac (build in 1994-1998) at KEK, we sent a questionnaire to expert operators in order to investigate and evaluate the Linac operation software from their points of view[1]. As a result, some bases were shown for the idea that any person who operates accelerators regularly should carry forward the development of application programs for the console.

This paper discusses the proposition and system of the operation software development environment to improve the operation from the points of view of operators based on an investigation. We also examine the problems necessary to consider concerning the new system realization.

### 2 Operation software evaluation

When the accelerator is in regular operation in the E/P Linac, the shift operator (KEK staff and some company persons) runs the Linac. They use the operator console, which was made by others, who take care of accelerator devices or who work in the computer field. In a human interface (HI/F) and an operator console window, or others being often built in the past by persons who are not proper operators, the operator must learn the functions and manner of operation. It has been pointed out by expert accelerator operators that the things which were built by others isn't always efficient and easy to use by operators. It was proved by doing a consciousness investigation of operators that making a HI/F which can reflect the opinion of expert operators is exclusively needed.

### 3 Operation phase of the accelerator

The operation of the Linac can be classified into the following phase as below, which are meaningful in our discussion:

- 1) Accelerator design, the simulation phase;
- 2) Partial test ( equipment unit ) running;
- 3) Linac start-up (or, shut down) operation;
- 4) Adjustment operation (it includes beam commissioning, machine study, etc.);
- 5) Normal operation (pattern operation, the daily routine work);
- 6) Diagnostic work for the Linac problems; and
- 7) Operation for maintenance.

There are reasonable requested specifications which are different from each of the above phases. It is desirable to include its own operation and display windows at every phase. As the area becomes very big when treating all of the phases, we will focus on the phase of the regular operation of clauses 3) and 5).

### 4 Hierarchical abstraction of the operation

At first, we focused on the regular operation phase among the Linac operation phases. Next, when examining operation objects (generic task) in this phase, there is generally actually the following physical layer apart from the consciousness of the operator:

- 1) All kinds of operations on the HI/F (at top layer)
- 2) Database and calculations (middle layer)
- 3) Device operation (lower layer)

It is also possible to operate the final object in each layer. In a general discussion about accelerators, especially bigger ones, most devices are operated from the GUI of the HI/F. Moreover, our focus is set on limiting to this HI/F. When looking from the higher level layer, concerning the equipment, it is first abstracted in the device layer; moreover some object data are abstracted in the database at the middle layer[2]. That is, data exchange with the data base also means communication with the devices. All of these devices and databases at the HI/F are finally abstracted to a style which it is easy for the operator to understand using the GUI; convenient and functional operation is the target in this phase.

## 5 Functional and characteristic classification

As we clarified the hierarchical abstraction of the Linac operation phase and operation, the order of requirements was made as follows:

- 1) Various independent equipment operation ;
- 2) Cooperative operation among the devices;
- 3) Macro operation, automation;
- 4) Operation support based on the log trend;
- 5) Operation by the correlation analysis support;
- 6) Database support operation, contains CBR.;
- 7) Multimedia support operation;
- 8) Global network operation; and
- 9) DTP cooperation application.

The items mentioned above tend to expand as the computer control evolves. They are especially conspicuous from clause 3) to the 9). 9) is a new item which attracts attention; all of these become the load of the operator. We made a consciousness investigation by a questionnaire and extracted domain knowledge from these members who are regular Linac operators and are from a company. We tried a type of analysis which could improve a conventional operation system based on such an investigation.

## 6 Software evaluation by the questionnaire

Although the professional operator (from a company) and the KEK staff operator were investigated for this time, the question items were prepared 36 pages to nine professional operators. As the question item range, it investigated the evaluation of the concrete:

- 1) Operation and display windows;
- 2) Domain knowledge, consciousness investigation; and
- 3) Operators opinion for accelerator operation.

Each operator forms the area in which he is good based on operation experiences, has domain-knowledge judgement, and makes possible the operation and examination of the Linac. It became clear from our investigation that we can make good decisions for the future based on our empirical concerning the operation software. The software evaluation is done from the viewpoint of operation, not just its performance.

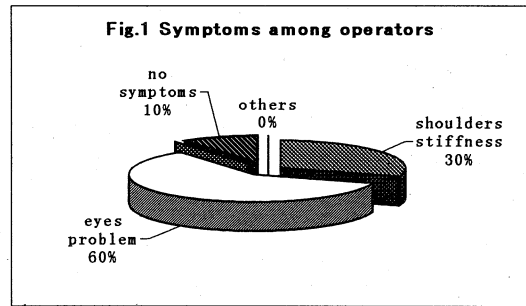
In the field of big science, except for the accelerator, an analysis of this species is a obviously big factor regarding operation.

## 7 Investigation result

### 4) About the human factor

There are many people who answered that their eyes were tired when using a computer concerning mental points; the shoulders stiffness, and so on, (Fig.1)

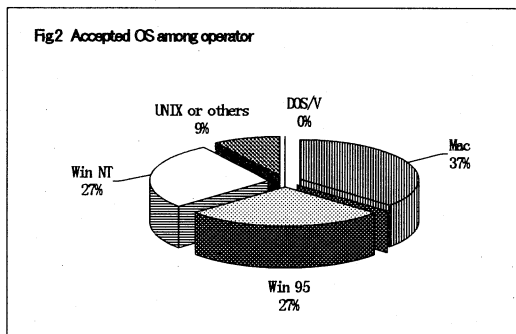
There was only one who answered that it was not a problem at all; most of the operators answered that there is some symptom;. 33% also feel some stress about watching a screen. The environment of the operation and the display show something which isn't always satisfactory, and contrary to the will to accept.



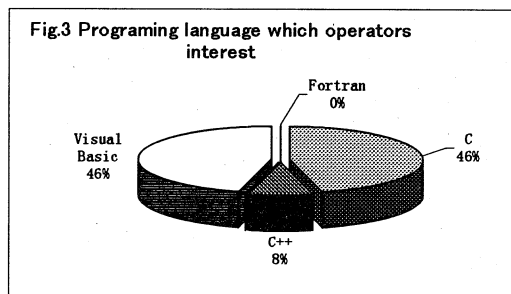
### 2) GUI of HI/F

Most operators have interest in computers, after having used a PC or Work Station, and having become accustomed to it. the most favorite OS is Windows95 also 22% of the operators liked UNIX. Operators want to select Macintosh, Windows95, and Windows NT. Windows95, and Windows NT are becoming very common.

This shows (Fig.2) that many operators want to use easy computers which are common in the market. As for the



color of the screen, the operator tends to like a few quiet colors; however, more than half of the operators expect easier pointing devices, such as another handwriting input equipment, etc.



For the languages (Fig.3), 70% of all operators have some skill, and are choosing C language and VB(Visual Basic).

3) We tried to evaluate each item which is a concrete screen of the console and received advice for an improvement plan. The tendency is described below:

#### a) Programs made by field specialists

There are many technical displays suitable for maintenance. During operation, these are not simple, and are not accepted by the operators. Only a professional often uses them, and there is a tendency for operators to intentionally put them a way.

b) Program made by operators

Programs are possible to be made by operators. The operators know what they need and what to do in Linac operation. As the developer himself use the programs, it is easy to introduce the opinion of the same operator quickly, and it helps to teach others. These programs are easy to understand in detail. A tendency is pointed out that operates well.

c) Software company-made programs

It is pointed out that it is necessary to be more polished concerning design. Learning details is difficult if it is upgraded so often, and thus usage tends to become less. As for frequent new software versions, the expense and specification arrangements become a heavy load.

4) Domain knowledge evaluation.

As for domain knowledge, each one has already made their professional field. A multimedia database would be useful for difficult correspondence. The mechanism which is always referred to, is learning improvement. It is possible to say that the mechanism which provides a present photograph, a drawing, operation log or a trend and etc, on the Web are now accepted. Based on their field knowledge, an operator strongly want to build convenient programs, personally. They also want to improve it continuously.

### 8 Problems in the analyzed results

Within the range which was first set as the investigation area this time, it is possible to say that it is necessary to provide an operation program development environment which is also possible for the operator to participate. Concerning the proposition, the following are problems:

- 1) The stress cancellation which comes from a computer.  
The word processor input work, and improvement of screen information.
- 2) Automation which the operator request  
It uses an its own composition windows concerning stress decrease.  
Programming by the tool of fixed procedures processing  
The reuse of non-fixed procedures processing by professional operator.
- 3) Information provision by multimedia
- 4) Learning support and domain knowledge expansion by model-base operation.

### 9 Improvements

Based on a previous questionnaire analysis, concerning an improvement plan of Linac operation software in the future, some propositions are listed below:

- 1) GUI component object [3] should be presented for console programming.
- 2) Procedure macro tools should be available, which would allow the operator to handle re-useful procedures.
- 3) Use and commercial package software linking; MS-based products are easy to link by OLE

- 4) Provide figures, pictures, and text by Web. (shown in Fig.4)
- 5) Server-client system, comprising with Windows 95/NT is already running. The user can use common files just like a local file.
- 6) Data-base access becomes available from MS products (Excel, Access, Visual Basic).

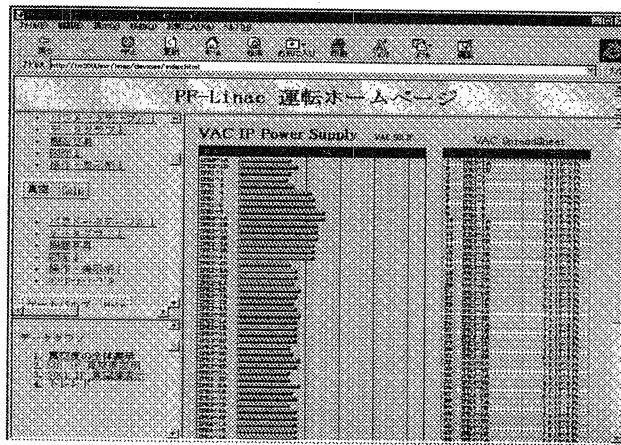


Fig.4 made by users on Web using object components.

For users and developers, additional learning costs are almost less for everybody regarding the above improvements.

### 10 Conclusion

Without losing the purpose of the control system of the design phase, to build a user I/F which is efficient, and, moreover, is convenient for operators obtain an answer should be partially possible in operation-program development. The provision of the easy and flexible development environment in which accelerator operators can participate in operation-program development is indispensable. The possibility of software construction which reflects the opinion of the accelerator operator has been proved.

### References

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