DETERMINING TRAINING RESOURCES AND REQUIREMENTS FOR NEW WEAPON SYSTEMS

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ABSTRACT

This paper presents research being done to develop a training analysis tool that will allow training decisions to influence the design of weapon systems earlier in system development than ever before possible and to update these decisions throughout the system's life cycle. Integration of training into the acquisition and engineering process is often a very slow process. The Air Force has developed operational systems without qualified maintenance and support personnel assigned to the systems. Under current operations in the acquisition arena, funding is available for only a single training analysis. By implementing a method to influence design with training issues early in development, a trained and equipped force prepared to maintain and support new weapon systems will be available as the systems become operational. The objective of the tool is to select tasks for training, assign tasks to instructional settings, determine task training times, and determine training resource requirements for new systems by using an empirical data set associated with existing systems.

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INTRODUCTION

Historically the Air Force has had difficulty performing timely analyses of the training resources and requirements for new weapon systems. The integration of training into the acquisition and engineering process of a new weapon system is a slow process and is often not initiated until design decisions have already been made. The determining factor for delaying training analysis is cost. Funding exists to perform the necessary training analysis only one time. Therefore, training analysis is shooting at a moving target because several, if not all, of the parameters influencing training change throughout the acquisition process. By delaying the training analysis, the opportunity to influence the design of the weapon system with training concerns and constraints is lost. In addition, the possibility of fielding an operational system without sufficient numbers of qualified maintenance and support personnel increases. Many tools already exist that can aid in the development of training, but the Training Resources and Requirements (TRR) tool stands alone as the only Air Force training tool imbedded in an integrated set of human systems integration analysis tools.[1]

NEED FOR AN INTEGRATED SET OF ANALYSIS TOOLS

Designing a new weapon system is a very complicated process with many tradeoffs taking place. The design process attempts to achieve the best blend of equipment, training resources and requirements, organizational and job structures, and individual worker-aiding technology domains to produce a weapon system able to meet its mission and performance requirements at the least cost. Figure 1 displays this complex process. If the training analysis is performed independently of these other domains, the value of the analysis diminishes. By including the training analysis in an integrated set of tools, training can be considered at the beginning of the acquisition process and can be used in subsequent tradeoff analyses to moderate training requirements of new systems. Integrated training analysis can automatically update training metrics as manpower parameters or personnel profiles change. Training parameters can be modified as the weapon system matures through the acquisition process to show training effects on system cost and performance.[2]

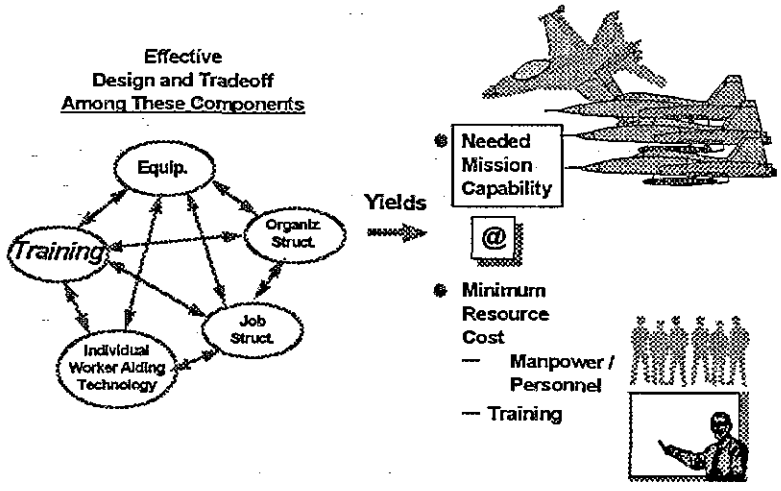

Figure 1 — Complex Process of System Design

MANPOWER, PERSONNEL, AND TRAINING IN ACQUISITION DECISION SUPPORT SYSTEM

The TRR tool is one of thirteen integrated tools in the Manpower, Personnel, and Training in Acquisition Decision Support System (MPT DSS). The MPT DSS is being developed to support Human Systems Integration during weapon system acquisitions by providing never-

before-available analysis capabilities and reports, such as MPT cost estimates over the life cycle of a new weapon system. The MPT DSS allows the users (Program Managers, Integrated Product Teams, Operational Commands, and Defense Contractors) to examine the interaction of the various domains in the Air Force and to attempt to optimize system design by conducting tradeoffs between the domains.

Figure 2 presents the MPT DSS process. The first step of the process is to gather as much necessary data as possible so that it all resides on a single computer

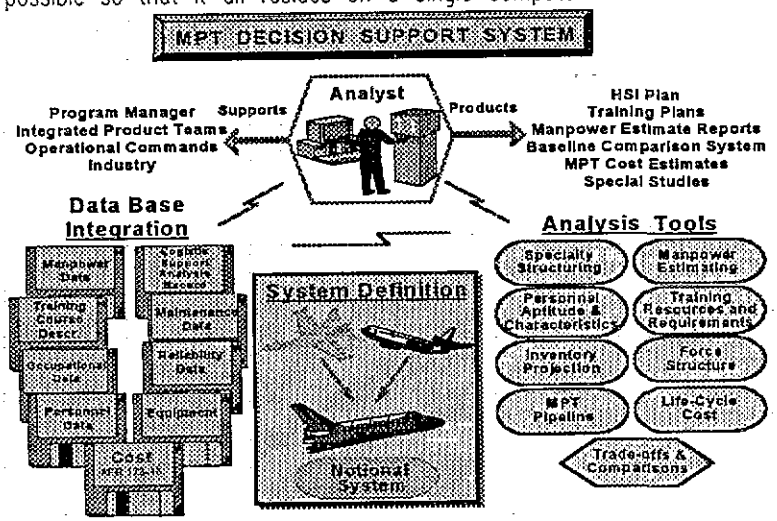

Figure 2 — MPT DSS

system. A subsystem within MPT DSS assists the user in retrieving data from geographically separate, unrelated data sources to build a single integrated MPT database. The user can then build the equipment lists and required maintenance task lists needed to conduct MPT analyses for a new weapon system. Using these task lists, the user can step through various types of analyses, such as a training analysis, using the analysis models within the MPT DSS. A combination of comparison and tradeoff tools allows for tradeoffs and sensitivity analyses to assess the impact of MPT and system alternatives.

Each tool in the MPT DSS relies on the other. For example, the TRR tool uses as input results from other tools to obtain data such as task difficulty ratings, projected inventory, and required man-hours to support the system by specialty. The data from the TRR, in turn, are used in analysis performed in other MPT DSS tools. The integration of the tools allows for the user to see the macro effects of making micro changes to individual models.

TRAINING RESOURCES AND REQUIREMENTS TOOL

Since the MPT DSS focuses primarily on the very early stages of the acquisition process, the TRR tool has narrowed its focus to Military Standard (MIL-STD) 1379D. The ultimate goal of this military standard is to enable the Government to identify more accurately the data or information the Government must have to fulfill a training requirement.[1] Since the standard has been prepared for joint service use, tailoring the model to this standard is critical to the acceptance of the TRR. The primary objective of the tool is to lay the foundation of the training required to maintain and support a new weapon system once it enters the operational inventory. To lay this foundation, the tool allows the user to select tasks for training, assign tasks to instructional settings, determine task training times, and determine training resource requirements. It has the capability to determine training requirements for all types of Air Force training (e.g., technical training, on-the-job training (OJT), and field training detachment (FTD)).[3] The tool is to be used primarily at the initial stages of acquisition, but it also has the potential and fidelity to be updated and used throughout the life cycle of a new weapon system.

The TRR tool exploits Microsoft™ Windows capabilities to simplify the user interface. The input/process/output (IPO) screen (Figure 3) is the roadmap for the TRR tool. Each ellipse or block represents a step in the analysis process. A color scheme identifies which steps have been accomplished and which is the most logical next step. The IPO also identifies the optional steps. An additional feature the tool provides is the "Notes" feature. Throughout the analysis, the user can document decisions made and why they were made. This leaves an audit trail to support the decisions when audited at a later date in the acquisition process. A new analyst would be able to pick up a study and use the audit trail and IPO to continue the study where it was left off. The TRR also provides an extensive "Help" system. The combination of all these aids provides the support necessary for a successful run through the model.[3]

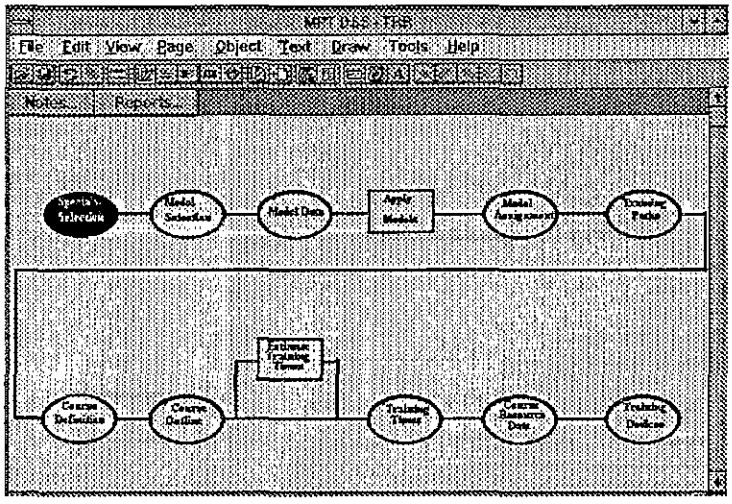

Figure 3 — TRR IPO

Inputs

As mentioned earlier, the TRR tool is just one of several tools in the MPT DSS. In fact, the TRR gets most of its data directly from the other tools. The Personnel Aptitude and Characteristic tool within the MPT DSS determines aptitudes and characteristics of the personnel. The Inventory Projection tool projects the personnel inventory for the life cycle of the weapon system and the Manpower Estimation tool simulates the required man-hours needed to maintain and support the system. The TRR uses all of this information in its analysis.[1]

Process

Specialty Selection – Before starting a training analysis, the user must determine which specialties to analyze. The TRR lists specialties and identifies which have courses already developed and the design differences categorized between the tasks performed by the new weapon system and existing systems. The user's concentrated effort should be the specialties with a highest degree of design differences. Courses required by existing systems will probably not change for those specialties that have a low design difference, so the required training resources will not change.

Task Selection Model – The TRR determines the tasks from the selected specialty that need training. The user will have a choice of four task selection models: 1) Training Emphasis, 2) Training Recommendation, 3) Multi-Factor Model, and 4) Train All. The Training Emphasis model bases its calculations on task factors from occupational surveys. The occupational surveys have a training emphasis factor, or a rating of which tasks require formal training for first-term personnel. The Training Recommendation model uses Logistics Support Analysis Record (LSAR) data. LSAR data have a single-position code indicating whether a task needs training and what type of training is needed. This training does not include equipment familiarization. The Multi-Factor Model allows the user the choose from a list of task selection factors and develop a new model. The following are the available factors:

- Training Emphasis
- Task Difficulty
- Percent Members Performing
- Average Percent Time Spent
- Mean Time to Repair
- Mean Operational Units Between Failure
- Hazardous Maintenance Procedure
- Task Criticality
- Training Recommendation.

The TRR obtains these factors from other tools within the MPT DSS or from LSAR data. The final task selection model is actually just an option to select and train all tasks performed by the specialty.[3]

Instructional Setting Selection – In addition to selecting tasks to train, the TRR must determine the setting to train these tasks. Each task can be trained by either formal training or OJT. The Air Force Occupational Measurement Squadron has created Automated Training Indicators (ATIs) for each task that help make training decisions using occupational survey data. The ATI value includes the percent members performing the task, training emphasis, and task difficulty. This value is used in accordance with the Course Training Decision Table in Air Training Command Regulation (ATCR) 52-22 to make 'level of training' and 'instructional setting' decisions. Air Force Utilization and Training Workshops have had success using the ATI value in making training decisions. Since the required data are already in the MPT DSS, it is appropriate to incorporate this proven model into the TRR. This model is an effective device to predict instructional settings for existing tasks.[4]

The TRR includes an additional instructional setting selection model for new tasks, the ATI Man-Hour model, since the percent members performing a task is not available for new tasks. It should be assumed that all members of a specialty will be performing the new task, so a better indicator is the predicted total number of hours spent per year on the task. The percent members performing is replaced with the annual hours spent on a task in the new model, but the ATI Man-Hour model still uses the other two indicators to stay consistent with the original ATI model.

The user interface for the instructional setting selection model allows the user to choose between the original ATI model, the ATI Man-Hour model, and manual selection. If the ATI Man-Hour model is chosen, the user must set a high and moderate ATI frequency cutoff value.

After selecting the task selection and instructional setting models, the user has the opportunity to view the data to ensure that appropriate data are available to support the analysis. If too many elements are missing, the user may want to reevaluate the chosen models. If the data look good, the user applies the selected models and receives a display of the results. The user will see a listing of tasks and the recommended instructional setting. At this point the user has the capability to override the outputs from the models. Overriding the suggestions from the models is a good reason to implement the 'Notes' function of the TRR. Anyone else who used the analysis in the future could call this function and read the rationale for overriding model results.

Training Pipelines - The next phase of the analysis is to develop courses and include them in a training path, or training pipeline.[3] The user can select an existing path to copy, edit, or delete, and can also create a new path. The user identifies each path by a user defined path name, start year, and end year. If the new path is very similar to an existing path, the user should just copy the existing path. By copying a path, all the courses and course information is available for modification. The rest of the work within the TRR uses the selected path until the user returns back to this point and selects another path.

After determining the training pipeline, the analyst defines the courses. The user assigns courses to the training path. Three different types of courses can be added to the path: technical training, OJT, and other (e.g., FTD, Mobile Training Teams, Professional Military Education, Career Development Course, and correspondence). The user can use the New System Training Plan or review of existing courses (AFM 50-5, Training Management System) to identify courses.[1] The user can copy courses from a list of established courses, and then make modifications. This prevents duplication of work that has already been performed.

The user must define a list of elements for each course. Depending upon the type of course, the tool needs different combinations of these elements. The first element is the course number (Figure 4) which includes the responsible training center, training type designation, students for which designed, planned area of training, activity conducting training, and Air Force Specialty Code (AFSC). The course numbering system used is the standardized method of numbering courses, according to Air Training Command Regulation (ATCR) 52-21. The TRR library system lists this information to aid in the development of course numbers. The other elements that make up the course definition include the course title, skill level, security class code (in the TRR libraries), preceding course within skill level, and whether or not the course is weapon system specific. The user can also determine

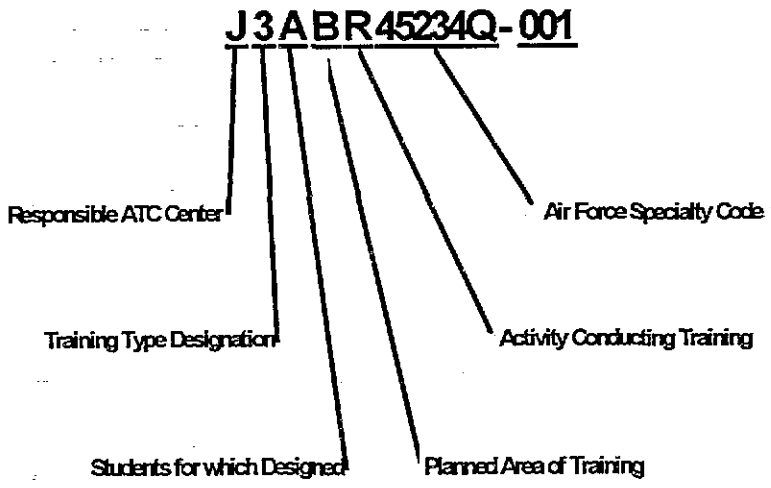

Figure 4 — Sample Course Number

whether or not to calculate resources from any given course. The TRR only generates automated training cost summaries for resident special training, resident regular training, and field technical training.[3]

When defining the courses, the user assigns each task requiring training to a course. The TRR provides a list of tasks selected for training for the given specialty with their appropriate courses. The user assigns each task to a single course. The user will have to define enough courses to train all tasks requiring training.

With the course definitions complete, the TRR builds the training pipeline (Figure 5) for the given specialty by using the course skill level and preceding courses. The training pipeline is a graphical representation of

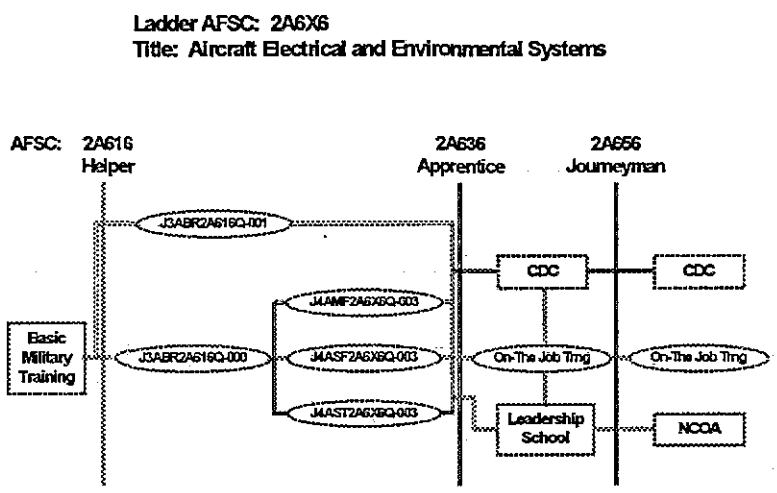

Figure 5 — Training Pipeline

the training requirements for personnel within a given specialty. By viewing the pipeline, it is evident what courses a career path require and at what skill level they are required. The TRR uses the training pipeline interface to access the different courses for the remaining steps of the process.[4]

Course Outline – After creating courses and assigning them tasks, the user must go back and begin to fill in the details by developing the course outlines. The goal of the TRR is not to build course curriculums and objectives but to determine the required training resources and requirements for cost analysis and tradeoff studies.[1] For example, tasks can be realigned within the specialties of a new weapon system, and the analyst may want to know the implications of making such changes. An analyst must be able to determine resources required for each course when these tasks are reshuffled. The course outlines only have to be at enough detail to determine the required resources to train the tasks.

For system specific courses, the courses break down into blocks and units. The tool can assign tasks to these course modules, which allows for analysis in greater detail for those courses that are high drivers in the new weapon system. For non-system specific courses, the TRR estimates resources without the in-depth analysis. Other weapon systems influence their course outlines.[4]

Training Times – Now that tasks are assigned to the courses, blocks, and units, the TRR helps determine training times and methods/media for the tasks. The TRR tool allows for the user to enter the task training times manually, but it also has the capability of estimating the required training times. It uses modified functional relationships from the Training Analysis Support Computer System (TASCS), developed by the Training System Program office at the Air Force's Aeronautical Systems Center, to predict required training time.[5] The TRR applies each task to the various TASCS task learning categories (Figure 6) in order to calculate the task training time. The TASCS equations use information that the TRR and MPT DSS already provide for other calculations. The training times coming out of these equations are adjusted to reflect the skill, knowledge, and ability similarities between tasks within a unit, block, or course, depending upon the lowest level course module with assigned tasks. The TRR uses a table containing the percentage of time used for each method and media by course type to divide the total training time into method and media assignment. These tables are accessible and modifiable by using the TRR libraries.[4]

After all of these calculations are complete, the user has a chance to review the results. The results are only recommendations and the user has to input the final training time. The user may be a training expert and choose to override all calculated times, but these calculations are available to assist in making educated estimates.

Task Learning Category	Individual Methods/ Media of Instruction	Calculations for Task Training Times
Explanation	Classroom Lecture Questioning Discussion Self-Directed Audiovisual Media	Task Difficulty x 60 min.
Demonstration	Classroom Demonstration Demonstrator	Task Difficulty x Task Length x 1.5
Cognitive Part Task	Laboratory Programmed Questioning Procedure Trainer Panel Trainer Interactive Courseware	Task Difficulty x Task Length x Task Criticality x .2
Psychomotor Part Task	Laboratory Hands-on Performance Practical Exercise Part Task Trainer Operational Equipment	Task Difficulty x Task Length x Task Criticality
Full Task	Laboratory Operational Environment Training Exercise Simulator	(Task Difficulty)^2 x Task Length + 1

Figure 6 — Task Training Time Functions

Course Resource Data – To assist the user in defining the course resource data, the TRR provides a library of historical courses from Air Education and Training Command's Programmed Technical Training data base allowing the user to find a comparable course. The required course resource elements are:

- Course Length
- Attrition Rate
- Programmed Group Size
- Academic Weeks Per Year
- Percent Permanent Change of Station (PCS).

Once again, the user can use data from an existing comparable course, or the user can input new data. Each of these elements influences the training costs of new systems.[4]

Training Devices – The final step of the TRR process is to define the training devices necessary for the training media. In an earlier calculation, the training times were determined by method and media. In order to put a cost on the training media, the TRR assigns training devices to each media. For each training device, the user enters its developmental cost, cost per student hour, and the hours spent using it per course.[4] Once these data are entered, the process is complete for the course being analyzed. At this point, the user can build another course for the current training path, build a new training path, select a new specialty to analyze, or end the TRR analysis.

Libraries

Throughout the discussion of the TRR process, several references were made to the TRR libraries. The libraries store the information that will be consistent across all TRR analyses. This information includes:

- Training Methods
- Task Selection Models
- Media Types
- TASCS Categories
- Course Location
- Course Types
- Student Types
- Training Activities
- Training Areas
- Course Security Classification
- ATI Library
- Media Classes.

All the libraries, except the ATI Library and Media Classes, are editable by the user. Since these libraries are constant across all TRR analyses, the edits made by the user are saved as a permanent part of the library.[3]

Reports

Another feature available in the TRR is the report function. Figure 7 shows the available reports. These reports display all of the information that the user may need to give to others in a more presentable format.

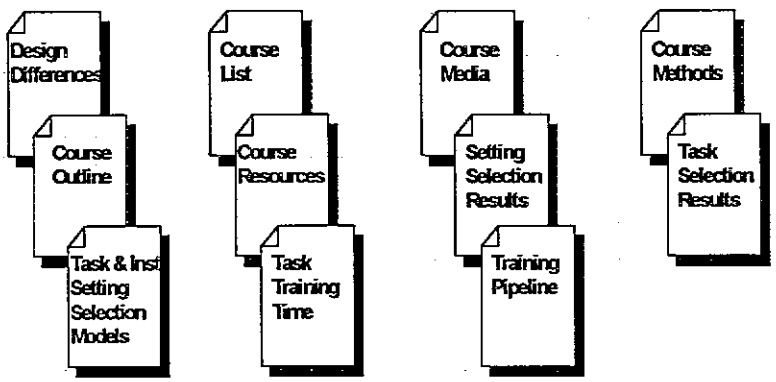

Figure 7 — TRR Reports

Outputs

Since the MPT DSS is an integrated set of tools, other tools will use output from the TRR. More specifically, the Force Structure tool that calculates manpower and develops the force structure required to support a new weapon system. The TRR feeds this tool the course information (i.e., course length, number of students, course setting, and method of training) so it can calculate the instructor requirements.

The goal of the Life Cycle Cost tool in the MPT DSS is to estimate the cost of MPT elements over the life cycle of a new system. It pulls together all the resource information to develop estimates of the MPT life cycle cost. The TRR feeds this tool with the complete course information, including training devices. With this information, the MPT DSS can estimate the training costs for the life cycle of new weapon systems, as well as the complete MPT costs.

PAYOFFS

The potential payoffs of including a tool such as the TRR in an integrated environment are great. Any design, personnel, or policy decisions made on a new weapon system have an effect on training, and this effect can now be reflected without starting a new analysis for each option. For some changes, the analyst will have to refine the TRR analysis, but for others it will update automatically. This allows an analyst to perform a training analysis during the early stages of the acquisition process so that training is included in the tradeoff decisions of designing a new weapon system.[2]

Another advantage of being in an integrated set of tools is that simple changes can be made within the tool, such as changing on-site classes to distant learning, and the cost implications are easily calculated. This allows for training optimization tradeoffs to be performed after the training analysis is complete.

SUMMARY

The TRR is a tool that provides the capability to conduct training analysis earlier in the acquisition process than ever before. By using the structured analysis approach of the TRR, an analyst can develop training paths for the different specialties required to support a new weapon system. The training paths will include course outlines with training times for the different methods and media for training. The MPT DSS pulls together these requirements and resources in the Life Cycle Cost tool to show the influence of training on the life cycle costs of the new system. Not only will this allow for a capable force to be trained and equipped when the new weapon system becomes operational, but an analyst can perform analysis early enough to have influence on the design and policy decisions throughout the acquisition process.

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