THE SIMULATOR INSTRUCTOR - A READINESS PROBLEM

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BACKGROUND

The increasing pressure to extend utilization of simulator training, the continuing increase in sophistication of weapon systems, and the accelerating application of advanced simulator technology are creating new sets of problems for the simulator training system. Many of these problems are centered on one of the key sub-systems - the instructor. Most of these problems which will be discussed in the following paragraphs, stem from the failure to treat simulation training as a system, and in particular, the failure to adequately structure the role of the instructor and to design the required interface. Thus, while wide-angle visual systems, complex motion platforms and sophisticated CRT's have been added, the functions and interface for the instructor have been largely ignored and the resultant instructor console becomes a victim of design "fall-out." To complicate the problem, the characteristics of the instructor pilot and the operational training concept are also changing significantly.

Feasible solutions which have been advanced, range from one extreme represented by complete automation to the other requiring highly trained and specialized simulator instructors. Neither is currently implementable or acceptable. Yet, little other effort has been expended to resolve the problem.

The dilemma created has parallels in other fields where full scale application of technology, especially computer technology has occurred with almost equivalent disregard for the requirements of the human decision maker. Automated materials handling presents an excellent example. One airline, for example, after installing a sophisticated automated cargo handling system, was forced to fall back and redesign the system - "We had to go back to the time when man, not the machine, was the boss of cargo handling." [4] Perhaps the time has also arrived to return to the concept of the instructor as the "boss" of simulator training.

INSTRUCTOR PILOT STUDY

Recognizing that major changes were occurring in simulator design and that instructor problems were arising, the Human Factors Laboratory of the Naval Training Equipment Center undertook a study of the instructor pilot's role in simulator training with the ultimate goal of defining and designing the required instructor consoles. The effort included a survey of the current role of the instructor pilot (IP) in readiness training, an analysis of instructor functions and the development of instructor console design concepts including the feasibility of modularized and standardized consoles.

The study began with an analysis of a generic simulator training system. Figure 1 illustrates the major subsystems considered, i.e., the student, the simulator, the syllabus, and the instructor. The preliminary analyses were directed to identifying the interface requirements for the instructor subsystem and to developing a structure for the collection of data during the survey of simulator training.

In brief, the results[2] showed that each of the training subsystems generate broad demands on the instructor subsystem.

● The student, e.g., requires briefing, monitoring, demonstration feedback, evaluation, and debriefing.

● The syllabus requires implementation including identification and selection of appropriate mission and performance criteria as well as structuring of simulation parameters and control points.

● The simulator requires initialization and operation, and additional simulation support such as air-traffic control and ground crew functions.

Thus, the instructor subsystem provides the integrating function for the entire training system as well as providing missing simulation models and ancillary functions not performed by the other subsystems. As Caro pointed out, "A training program is the manner in which the well-qualified instructor uses the appropriately designed simulator to establish the clearly defined course content within the skills repertoire of the trainee."[1]

The characteristics of existing subsystems were surveyed. The following paragraphs summarize the results.

SYLLABUS PROBLEMS

The typical simulator flight training syllabus is based on or "borrowed" from the flight syllabus. Thus, it rarely identifies or structures in the required detail those parameters and functions which are not controllable in flight. This is not a trivial

SIMULATOR
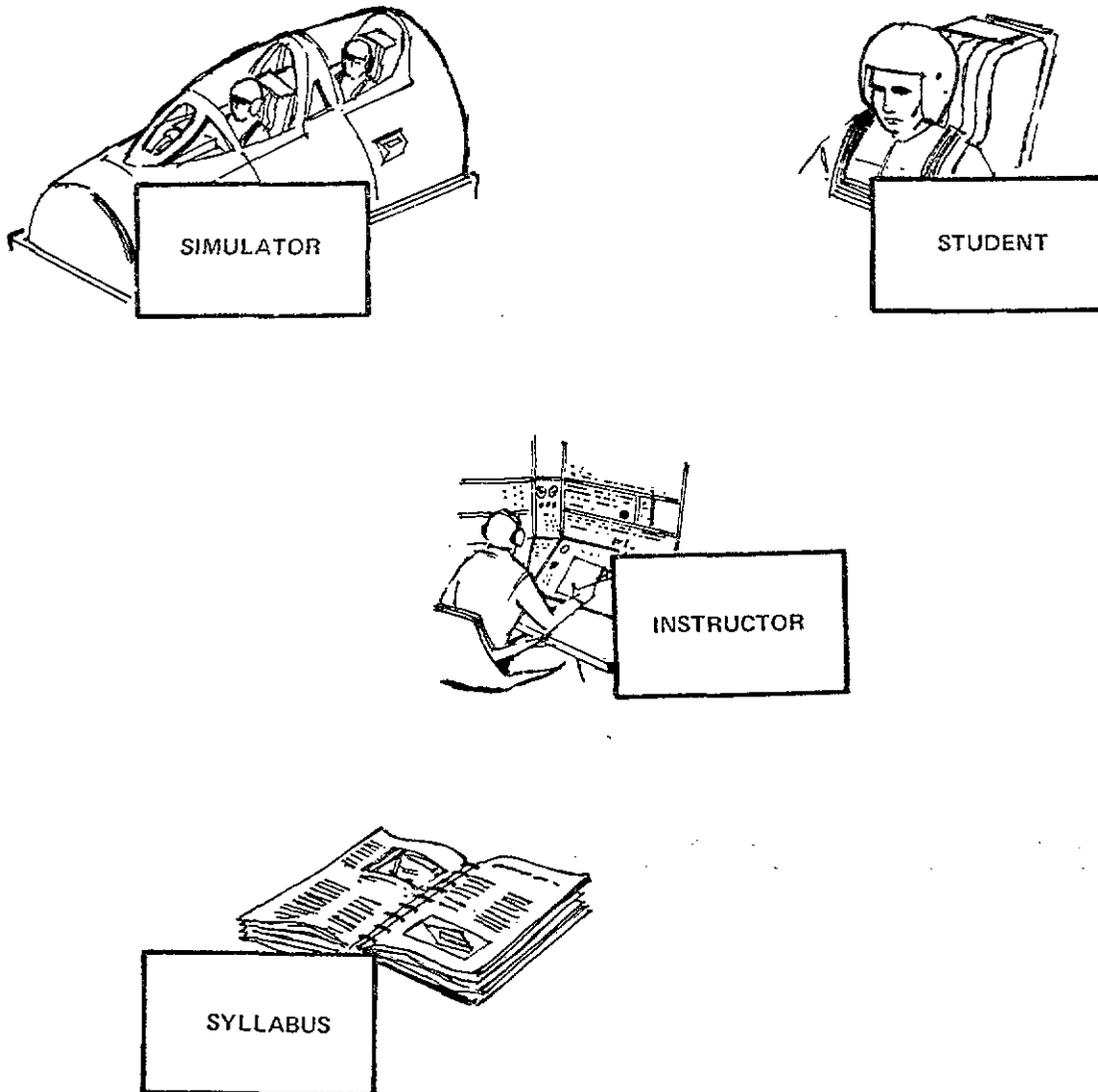
STUDENT

INSTRUCTOR

SYLLABUS

Figure 1. Simulation Training System Components

set and in a modern simulator, for example, includes:

- environmental variables such as winds, temperatures, turbulance, variation

- location variables such as latitude/ longitude, attitude, runways

- radio-navigation aid variables such as type, frequency, identification

- visual variables such as ceiling, visibility, lighting

- malfunctions and emergencies onset, development and resolution

- simulator operating controls such as motion actuation, visual actuation, start, reset

- training controls such as freeze, demonstrate record, replay

- vehicle configuration including fuel, stores

- operational environment including targets and characteristics, jammers

Thus, a modern simulator will contain hundreds of parameters and controls which must be set. While some automation exists, the impact on the instructor is not correspondingly reduced since he must at least verify the configuration. The burden on the instructor is obviously sizeable when the syllabus does not identify or structure the flight training envelope much less the mission scenario and enemy tactics.

INSTRUCTOR CONSOLE PROBLEMS

The instructor consoles in digital operational trainers can be grouped into two types based on vintage. The first generation trainer consoles typified by the F-4J trainer (2F88) can be described in terms of:

- "wraparound" console

- "repeater" cockpit instrument panel

- displays and controls arranged by aircraft system

The consoles were reasonably well human engineered within the constraints involved. In general, they were designed for a two- to three-man operation, at least one of whom is a simulator technician well qualified in manipulation of the complex consoles. Instructor personnel - pilots and naval flight officers - "boss" the training evolution.

The second generation consoles such as the T-2J trainer (2F101) are typified by the extensive use of CRT's and keyboards for all display and control functions. Mechanization has generally involved wide use of both text and pictorial displays. Unfortunately, it appears that the wide capability of graphics displays has led to an instructor console design philosophy of providing a display and a control for any and everything. Thus, any requirement is bound to be satisfied. Unfortunately, this has led to CRT's with hundreds of pages of text, displays, and indexes resulting in a distinct probability that the instructor will fall behind the training evolution in the first minutes of operation.

INSTRUCTOR PROBLEMS

The instructor subsystem in operational trainers presents another set of problems which closes the loop on the dilemma. The study revealed that the role of the instructor and the supporting or assisting role of the technician varies with the nature of the weapon system involved. In single place aircraft systems, the technician generally contributes significantly since the trainer is generally a weapon system trainer. The system itself is complex, and no other instructors are involved. In multiple-crew aircraft, the role appears to vary with mission of the system and the role of the pilot in the system.

Where the pilot is almost exclusively concerned with vehicle control, the IP can and does conduct the simulator training generally on operational flight trainers (OFT) with little if any assistance. Where the pilot is intimately involved in multi-crew system operation, the IP functions as one of several simulator instructors at the console(s) with other instructor(s) and technician(s) assistance. Yet, in general, the instructor consoles are designed alike; i.e., with little consideration for the instructor team composition or functions.

Finally, the IP, almost without exception, is not trained in simulator operation or more importantly, in simulator utilization in support of the syllabus. Very limited on-the-job training is typically provided the IP.

In summary, the typical modern simulator training system in operation can be characterized by:

a. inadequately designed syllabus

b. ineffective interface or console

c. inadequately trained IP

PROBLEM SUMMARY

The problem is multifaceted and inter-acting. Although unique simulator syllabus development can and should be undertaken, it must consider the interaction with the instructor and the console. The console or inter-face cannot be well designed until the char-acteristics of the IP and the syllabus and training objectives have been identified. The instructor cannot be trained until his role is defined. Thus, the problem is a typical systems' engineering problem and as Machol summarized, "Because the problem cannot be adequately formulated until it is well under-stood, and because it cannot be well under-stood until it has been more or less solved, the two are inseparable."3

Thus, the requirement is for the inter-active analysis and trade of performance, constraints, and design alternatives.

INSTRUCTOR DESIGN CONSTRAINTS

The study of the IP in simulator training revealed that, at least in present training operations, the instructor subsystem could be characterized as follows:

a. The simulator IP is a relatively ju-nior flight instructor virtually untrained in simulator operation or utilization.

b. The console is designed for simula-tion variable control rather than for training functions.

c. Definitive simulation training sce-narios are seldom provided.

d. Briefing/debriefing capability is limited.

e. Standardization of training is mini-mal.

The picture is not unlike other system designs in which each component is designed independently to different criteria. Yet, tradeoffs and effective designs are feasible to most mixes of console designs and instruc-tor characteristics. For example, if qualified flight instructors are to be utilized with minimal training in simulator operation, then the characteristics of the console and sylla-bus might be stated as including:

(1) An IP console with maximum similarity to the cockpit to minimize IP train-ing and to take advantage of his already achieved skill in evaluating system perfor-mance. There would be little doubt that a qualified pilot could evaluate aircraft condi-tion more rapidly and meaningfully from a du-plicate of cockpit displays than he could from alphanumeric readouts on a CRT.

(2) Automated or technician sup-ported simulator initialization and opera-tion.

(3) A general standardized sylla-bus defined in operational terms for IP use.

(4) A detailed translation of the syllabus in simulation implementation terms for support personnel (or software mechaniza-tion).

On the other hand, if highly qualified and trained simulator instructors are to be utilized, a unique and sophisticated instruc-tor console could be implemented with little similarity to the operational cockpit.

Alternative designs depending primarily on instructor characteristics are clearly possible. Unfortunately, the typical pre-sent-day simulator incorporates both an in-structor console and a syllabus which are not designed to meet instructor requirements.

OVERVIEW

Effective simulator training can only be achieved by considering the simulator as part of a training system which includes the instructor, the syllabus, and the student. Design constraints, especially in terms of instructor characteristics must be iden-tified and reflected in the design of the instructor consoles. Similarly these con-straints, along with training objectives must be utilized in the development of the simulation training syllabus if efficient, effective, and standardized training is to be achieved.

The findings reported in the study of the IP's role in simulator training lead to the conclusion that the instructor personnel, at least for the near future, will be oper-ational personnel; i.e., operationally qual-ified pilots and Naval flight officers. Furthermore, minimal training in simulator utilization will be provided for many rea-sons including:

a. Simulator training will be "collat-eral duty" along with flight instruction and other squadron duties.

b. Transfer and rotation of personnel will preclude any extended training program in simulator utilization.

c. Multiple training functions of the instructor; i.e., academics, flight, and simulation will preclude specialization in simulator utilization.

Thus, simulator instructor consoles should be designed for utilization by

operational personnel with a minimum requirement for training in simulator utilization and a maximum utilization of existing IP skills and abilities. These design objectives are readily achievable with existing design technology and methodology.

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