Image Cover Sheet

CLASSIFICATION	SYSTEM NUMBER
UNCLASSIFIED	147222

TITLE

DESIGN OF THE PROVISIONAL EW ASSESSMENT MODEL

System Number:

Patron Number:

Requester:

Notes:

DSIS Use only:

Deliver to: NL

DEPARTMENT OF NATIONAL DEFENCE

CANADA

OPERATIONAL RESEARCH AND ANALYSIS

DIRECTORATE OF MATHEMATICS AND STATISTICS

DMS RESEARCH NOTE 7/94

DESIGN OF THE PROVISIONAL EW ASSESSMENT MODEL

by

Frederick W. P. Cameron

September 1994

OTTAWA, CANADA

National Defence / Défense nationale

Operational Research and Analysis

CATEGORIES OF PUBLICATION

ORA Reports are the most authoritative and most carefully considered publications issued. They normally embody the results of major research activities or are significant works of lasting value or provide a comprehensive view on major defence research initiatives. ORA Reports are approved by DGOR and are subject to peer review.

ORA Project Reports record the analysis and results of studies conducted for specific sponsors. This category is the main vehicle to report completed research to the sponsors and may also describe a significant milestone in ongoing work. They are approved by DGOR and are subject to peer review. They are released initially to sponsors and may, with sponsor approval, be released to other agencies having an interest in the material.

Directorate Research Notes are issued by directorates. They are intended to outline, develop or document proposals, ideas, analysis or models which do not warrant more formal publication. They may record development work done in support of sponsored projects which could be applied elsewhere in the future. As such they help serve as the corporate scientific memory of the directorate.

DEPARTMENT OF NATIONAL DEFENCE

CANADA

OPERATIONAL RESEARCH AND ANALYSIS

DIRECTORATE OF MATHEMATICS AND STATISTICS

DMS RESEARCH NOTE 7/94

DESIGN OF THE PROVISIONAL EW ASSESSMENT MODEL

by

Frederick W. P. Cameron

OTTAWA, CANADA SEPTEMBER 1994

ABSTRACT

The Land Tactical Electronic Warfare Equipment Project (L1246) is intended to provide the Canadian land forces with the electronic warfare (EW) systems that will carry them into the 21st century. The staff responsible for the project wanted a model of tactical EW that would permit the evaluation of various re-equipment proposals against the current capability. A provisional EW Assessment Model was produced as a first step towards developing a more comprehensive model. Although this paper on its own provides a sufficient description of the provisional model, it is intended to accompany a videotaped summary of the model.

RÉSUMÉ

Le but du projet de guerre électronique tactique terrestre (L1246) est d'équiper les forces canadiennes de systèmes de guerre électronique qui les amèneraient jusqu'au 21ième siècle. Le personnel responsable du projet voulait un modèle de GÉ tactique qui permettrait l'évaluation de diverses propositions de ré-équipment contre la capacité présente. Un modèle d'évaluation provisoire fut produit comme première étape vers le développement d'un modèle plus compréhensif. Quoique ce rapport par lui-même fournit une description suffisante du modèle provisoire, il fut ecrit pour accompagner un summaire du modèle sur bande video.

TABLE OF CONTENTS

DESIGN OF THE PROVISIONAL EW ASSESSMENT MODEL

Introduction

1. The provisional EW Assessment Model focuses on communications electronic support measures (ESM). Four of the main processes in communications ESM are shown in Figure 1. There are others such as jamming that are not shown here. Similar processes are involved in non-communications EW. Of these four processes, three (detection, interception, and location) are represented in the provisional EW assessment model. The analysis process is an involved process that apparently incorporates a number of heuristic procedures. Furthermore the procedures used by one analyst may not be popular with colleagues. There being no consensus on appropriate procedures for the analysis process, it has been excluded from the model for the present.

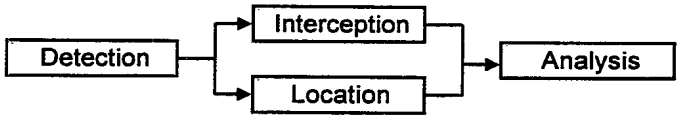


Figure 1: Four Components of Communications ESM

2. The design of the provisional model addresses a situation where BLUE EW resources are tasked against a RED communications threat. Traffic from BLUE and WHITE[1] communications facilities can also be represented since it contributes to ambient activity within the electromagnetic spectrum. This ambient traffic may be responsible for false alarms and other distractions that inhibit the BLUE EW systems from concentrating solely on the RED targets.

3. Apart from modelling the BLUE EW processes, the simulation must include a component to generate the message traffic that the EW system is targeted against. As already suggested, messages must also be generated on behalf of those communications

[1] In traditional military terminology the friendly side is know as BLUE and the opposition is known as RED (or alternatively ORANGE). WHITE is not a standard term, but will be used here to represent 'non-combatants' and others not aligned with BLUE or RED.

facilities (BLUE or WHITE) whose traffic could be mis-identified by the EW system as originating with the RED units. In the opening stages of an EW operation, this traffic may be as important as the RED traffic since the EW system must become aware of the ambient activity before it can detect new RED activity against the background.

4. A vidotape of the provisional model is available from DMS/EWORT. It complements this written description. More than any document can, the tape highlights the ease with which a particular computer simulation environment can be applied to new problems and the animation features that permit subject matter experts to absorb the model structure very quickly.

The EXTEND Simulation Environment

5. The EXTEND computer simulation environment[2] was used to develop the provisional model. In EXTEND, a model is constructed by copying icons from a library into a graphics window. For discrete event modelling, the available library provides all of the entities found in typical queuing models: e.g., arrival generators, FIFO queues[3], gates, exits, etc. Each icon has connectors at its edges which provide access to entities, in this case messages, that have been processed within the icon or to variables that have been calculated as part of the process modelled by the icon. Once moved into the window, the icons can be connected as required to construct a sensible model. Annex A provides a primer on the discrete-event modelling capabilities of EXTEND. Annex B provides a glossary of EXTEND icons that will be helpful in absorbing the remainder of the model's description.

---

[2] See the EXTEND documentation for details (Imagine That, Inc., *Extend*).

[3] In queuing theory, FIFO means first in first out. The reverse is LIFO or last in first out.

Overview

6. Starting with the four processes shown in Figure 1, the general structure of the EW Assessment Model developed as shown in Figure 2. However, the 'analysis' component from Figure 1 was dropped due to the current intractability of describing it. Figure 2 is based on a scaled-down diagram extracted from the EXTEND package and the resolution is such that individual icons cannot be identified. These icons are more readily

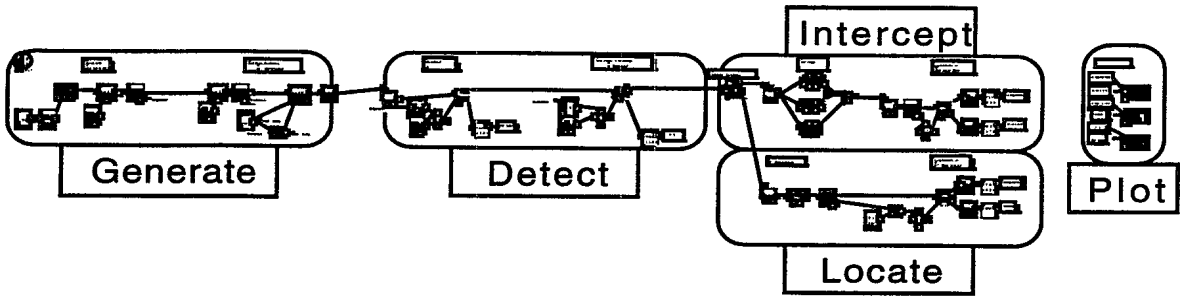


Figure 2: Overview of the Model Structure

identified in later figures where the scaling is less severe. Two components were added: one preceding the detection process to generate the necessary message traffic and the other on the far right to produce plots of the output of the model.

7. The Generate process is governed by the amount of radio traffic present. This traffic is partly a consequence of the RED communications activity, but must also account for some traffic from BLUE and WHITE radios. It is important to include the BLUE and WHITE traffic in the model when there is a potential for the BLUE EW assets to mistake it for RED traffic. Otherwise it can be largely ignored.

8. Battlefield Transmitters. Say that there are a number of transmitters on the battlefield representing some combination of BLUE, RED, and WHITE radios. In the provisional model each of these transmitters has a set of characteristics, namely: originator's identity, the mean rate at which new transmissions are created (as

transmissions per minute), the mean duration of a transmission (in minutes). The user can go to a spreadsheet and look up other characteristics of the originator including the identity of the transmitter's user and his location on the battlefield. The spreadsheets for suitable threats are not yet complete so sample data was used for the provisional model. A draft of the threat for a high-density threat of divisional size is available from DMS-EWORT should a reader wish to see the format intended for this material.

9. Generate Messages. The additional process — 'Generate' — creates message entities for the BLUE EW units to be assessed against. Messages will be generated from a Poisson process, where the mean number of messages is the sum of the RED message activity, plus the BLUE and WHITE activity for those messages that might be mistaken for RED traffic. In the model component called 'Generate Messages', messages are created with an exponential distribution governing the time between successive activations (without regard, at this point, to the identity of the transmitter). The model structure for this is shown in Figure 3. The executive icon (marked '1') is shown in the upper left corner. The system variable called 'Current Time' is accessed in the icon marked '2' and passed to a lookup table, '3', where it is used to determine the activity level in terms of a mean inter-arrival time. This time is passed to the generator icon, '4', where it governs the rate at which new messages are produced. Once generated, each new message entity passes to the right from the generator icon. At this point a random number (from the icon marked '5') is used to set an attribute in the message called originator in the 'Set Attribute' icon marked '6'. This attribute is

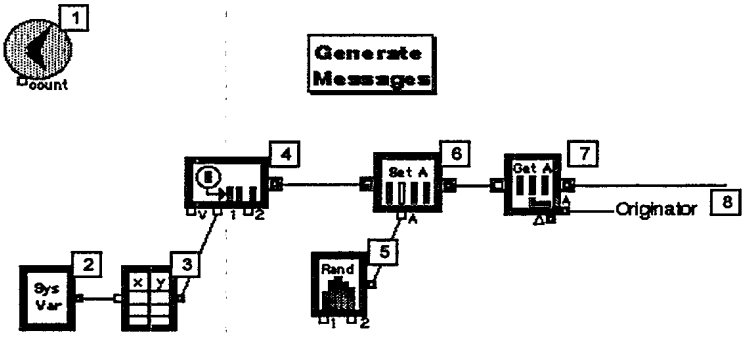


Figure 3: Generate, Part 1

immediately accessed in icon '7' and provided to the rest of the model on the connector labelled 'Originator' and marked '8'.

10. Add More Attributes. As a new message passes to the right, other attributes are added. The icon marked '1' in Figure 4 provides a message duration which is added to the message's other attribute (i.e., the 'Originator') in the icon marked '2'. In icon '3' this attribute is immediately accessed and provided to the rest of the model as the variable called 'Duration', marked '4'. The icon marked '5' provides the system variable called 'Current Time'. At this point the 'Current Time' is that instant at which a new message is processed through the icon marked '3', which, since no delays were imposed since the message was generated in Figure 3, is also the instant that the transmission started. This is provided to the rest of the model as the variable labelled 'SOT Time', '6', for start of transmission time. This represents the time at which the transmitter in question starts to emit radio energy. In icon '7' the SOT Time and the Duration are added together to determine the time at which the transmission will cease, called EOT Time or End-of-transmission time, marked '8'. In the icon marked '9', the SOT Time and the EOT Time are added as attributes of the current message. A third attribute is also set in this icon: an attribute called 'Proc Delay' for processing delay is initialized to the value zero. This attribute is used later in the model where it will be assigned the amount of time that an intercept operator spent on the given message. The 'Info' icon marked '10' is included so a user of the model can see a list of recently

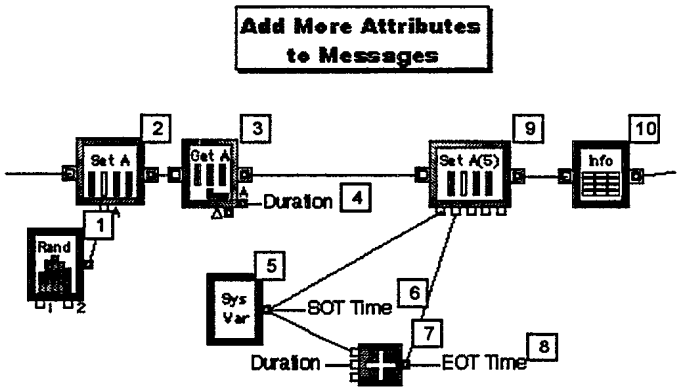


Figure 4: Generate, Part 2

produced messages; it is primarily for debugging purposes.

11. Even More Attributes. For the purposes of the provisional model, these attributes are sufficient. However, as the model develops further other attributes can be added. These might, for example, characterize whether the contents of the message are encrypted, the frequency used in the transmission, etc.

12. Line of Sight. Figure 5 presents the next stage in the model: determining if a line of sight exists between the transmitter and the ESM receiver. Each new message is temporarily placed in the first-in first-out (FIFO) queue marked '1'. This queue is simply a buffer to hold messages while some calculations are completed. In the icon marked '2' the originator number is used in a lookup table to determine the probability that line of sight (LOS) exists between the transmitter and the receiver. In the icon marked '3' a uniform random number is chosen. The decision icon (marked '4') compares the probability that LOS exists with the random number and uses the result to control the selector marked '5'. If the random draw determines that LOS exists, then the message will pass to the right for further processing. However, if the message fails the LOS check it exits the model at the icon marked '6'. The number on this icon ('1751') is a residual value showing the number of messages that exited the model due to LOS failure the last time the model was run. The output from the exit icon is labelled 'No Line of Sight', marked '7'. This variable is used later in the model to plot some of the results.

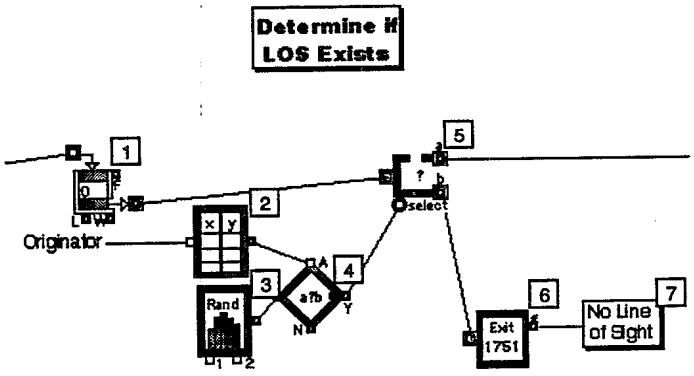


Figure 5: Detect, Part 1

13. Detection. For those messages for which LOS is deemed to exist, a detection check is made in the next component of the model, see Figure 6. The duration of a message is used to determine the probability that it will be detected. In the model an equation, marked '1', provides a 'threshold' probability of detection which is compared in a decision icon, '2', with a uniform random number, '3'. The decision icon controls a selector, '4', that will send the message further to the right if it is detected or to the exit, '5', if it is not. A count of the number of messages for which LOS was successful but detection was not is provided in the variable 'No Detection', marked '6'. For the provisional model, the equation in icon '1' is of the form: $P_d = 1 - A \cdot e^{-B \cdot d}$, where A and B are suitably chosen constants and d is the duration of the message, d = EOT - SOT. Such an equation means that the probability of detecting a very short transmission is near zero and a very long message is near one. By careful choice of A and B, suitable probabilities can be generated for messages of other durations.

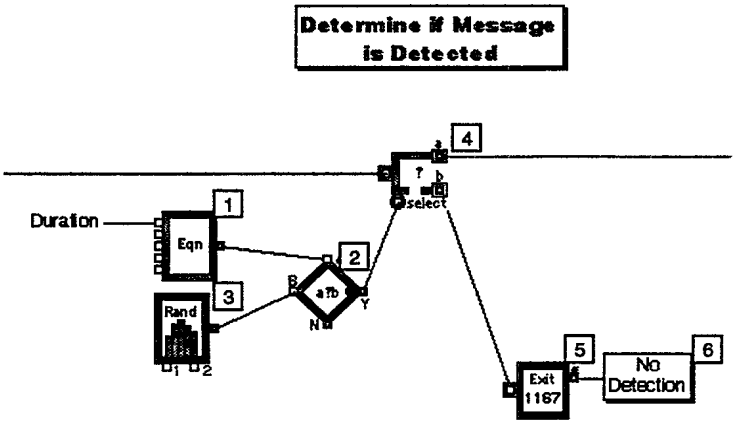


Figure 6: Detect, Part 2

14. Initiate Taskings. The detected messages that move to the right from Figure 6 generate taskings for the intercept operators and for the direction finding component as shown in the icon marked '1' in Figure 7. These taskings consist of duplicate entities that

contain all of the attributes of the messages themselves, namely, Originator, SOT Time, EOT Time, Duration, and Proc Delay. One of these duplicates is passed to a queue to await an available intercept operator, '2', and the other to direction finding operators along the path marked '3'.

15. Intercept Operations. The provisional model includes three intercept operators like the one marked '4' in Figure 7. Upon accepting a tasking from the FIFO queue marked '2', an intercept operator will hold a message until the transmission ceases and add this duration (the time from accepting the tasking to EOT Time) to the attribute Proc Delay, which was previously set to zero. Note that, if the tasking was accepted after the transmission ceased, this duration is zero and the value of Proc Delay remains unchanged. On leaving the intercept operators, the flows of completed taskings are merged by combiner icons like that marked '5'.

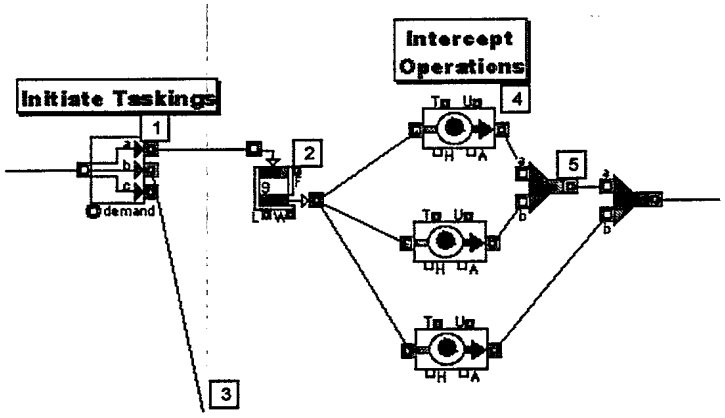


Figure 7: Intercept, Part 1

16. The combined flow of completed intercept taskings are segregated in Figure 8 into those that resulted in completed intercepts and those where no intercept was possible because the

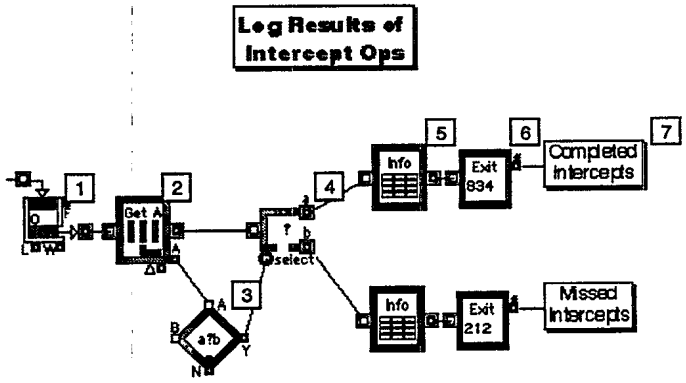


Figure 8: Intercept, Part 2

transmission ceased before an operator dealt with it. In this figure, taskings are held briefly in the FIFO queue marked '1' while the Proc Delay attribute is extracted in the icon marked '2'. The value of Proc Delay is used by the decision icon '3' to control a path selector '4'. If Proc Delay is positive the tasking proceeds on the upper path. This occurs only if the operator spent at least some time monitoring the transmission. If Proc Delay was unchanged by the intercept process from its initial value of zero, then it takes the lower path. On the upper path there is a information icon, marked '5', that allows the user to review the taskings of completed intercepts. The completed intercepts exit the model at the icon marked '6' where they are counted and provided to the rest of the model as the variable named 'Completed Intercepts', marked '7'. A similar progression on the lower path results in the variable 'Missed Intercepts' providing the number of intercepts that could not be completed.

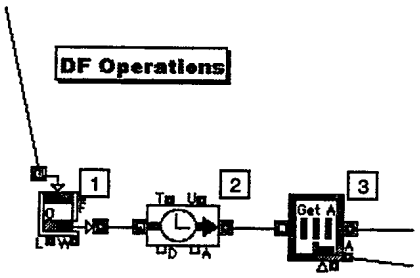


Figure 9: Locate, Part 1

17. The duplicate tasking for direction finding is dealt with in Figure 9. The taskings enter a FIFO queue marked '1'. As the DF system, represented by the icon marked '2', becomes available for a new tasking, the next one is selected from the queue. Processing by the DF system imposes a fixed delay and then passes the tasking to the icon marked '3' where the EOT Time attribute is extracted.

18. In Figure 10, the system variable Current Time (at the point that DF processing was completed) is provided in the icon marked '1' and subtracted from the EOT Time of the current transmission in the icon marked '2'. (If this difference is zero or negative, then the transmission ceased before DF processing was completed; and consequently the DF would be unsuccessful.) The time difference is used by the icon marked '3' to control a

path selector marked '4'. If the time difference is positive the tasking will proceed on the upper path. Here the progression, icons '5', '6', and '7', is much the same those at the end of Figure 8, with the number of successfully completed DF taskings provided in the variable called 'Completed DFs'. If there was not enough time to complete the DF process, the tasking proceeds along the lower path and the number of such taskings is provided in the variable 'Missed DFs'.

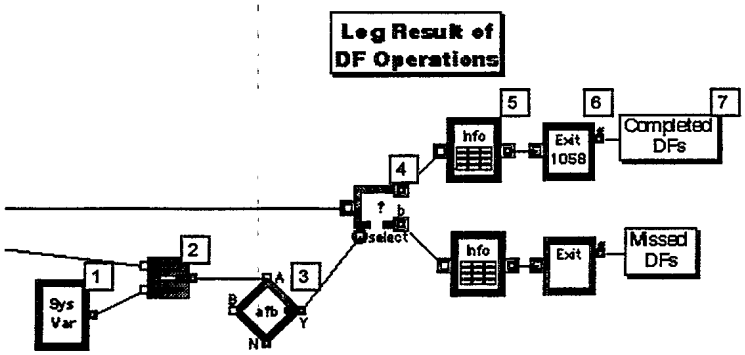


Figure 10: Locate, Part 2

19. Results from running this model are most easily interpreted in plots of various variables. In EXTEND this is facilitated with plotter icons. Figure 11 shows icons to prepare three plots:

a. 'Completed Intercepts' and 'Missed Intercepts' against time;

b. 'Completed DFs' and 'Missed DFs' against time; and

c. 'No Detection' and 'No Line of Sight' against time.

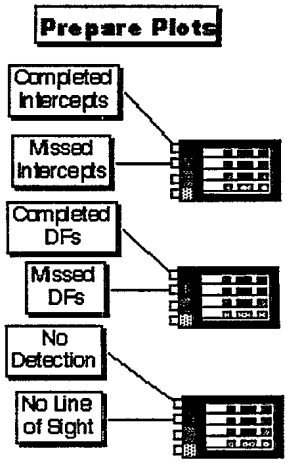


Figure 11: Plot

20. Figure 12 contains an example of what one of these plots looks like. These plots, like many of the other inputs and outputs used in the modeling environment, can be transferred to a printer or incorporated into another file, either of graphical or tabular data. This plot was produced by the upper icon in Figure 11; it shows the variables 'Completed Intercepts' and 'Missed Intercepts' over time. The Y axis on the right, for 'Missed Intercepts', is referred to as Y2 in the legend at the bottom of the figure. The time scale is for a period of 240 minutes.

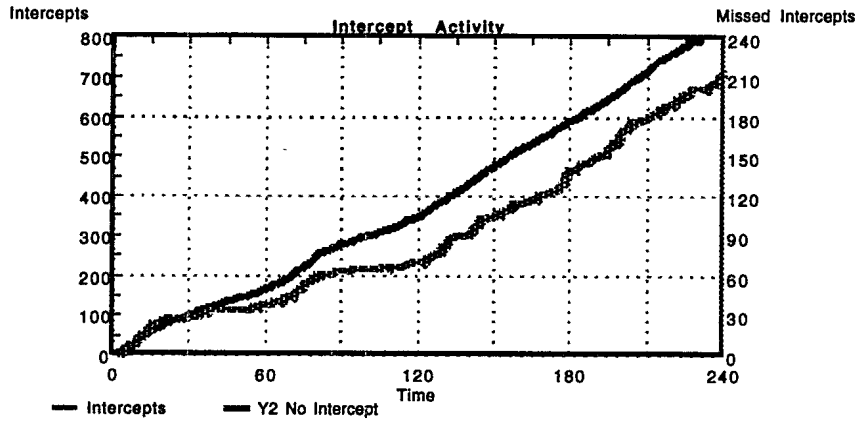


Figure 12: Example Plot

Summary

21. This description of the design of the provisional EW assessment model is intended to complement the videotaped model description available from DMS-EWORT. The model was developed using the EXTEND simulation environment and some familiarity with concepts in this package may be needed. Annex A is a précis of EXTEND and Annex B is a glossary of some of the EXTEND icons.

22. The model consists of five main components, three representing the communications-ESM processes of detect, intercept, and locate. Of the other two, one generates messages for the model and the other plots results of a simulation run.

References

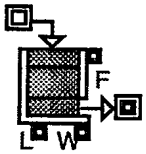
Imagine That, Inc., *Extend*, San Jose, CA, 1992

Pritsker, A. Alan B. *Introduction to Simulation and SLAM II*. 3rd ed., Halstead Press (Wiley), New York, NY, 1986

Annex A
To DMS Research Note 7/94
Dated September 1994

A PRIMER ON EXTEND

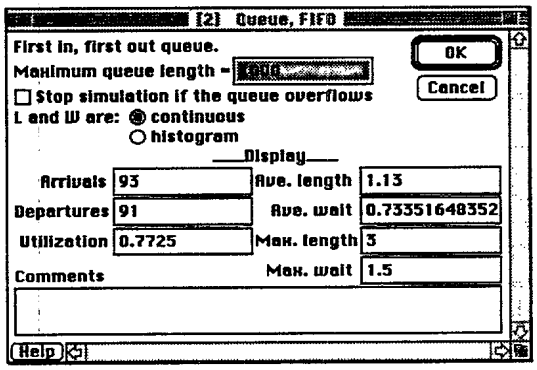
1. Simulations in EXTEND are designed using icons like the one to the right. The model designer selects appropriate icons from a library and places them on the computer screen in what seems a suitable juxtaposition. In this phase EXTEND resembles a computer-aided drawing package. The model developer need not be aware of it, but each icon has compiled computer code associated with it. As the icons are positioned in the model diagram, a simulation program is constructed from the compiled blocks of code. Once the developer has what seems to be a sensible diagram of the processes being simulated, he or she can try to run the model. If the simulation program that grew with the model diagram is consistent and all the necessary parameter values are available, the program will be executed to run the model. If there are problems running the simulation at this point, the developer will be prompted to check specified connections or to provide missing values. Note that even once a working model is available, the developer is still not confronted with the daunting task of dealing with the complex computer program that was constructed to his or her specifications.



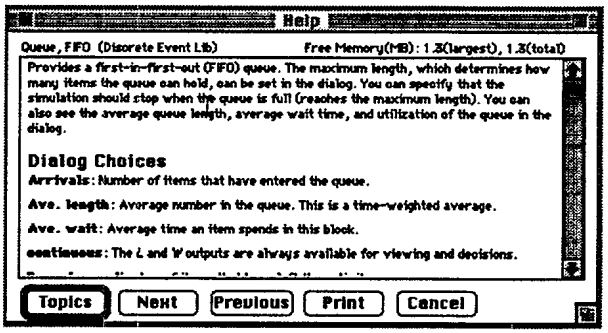
2. The available libraries provide all of the entities usually associated with critical event simulation (see Pritsker's *Introduction to Simulation and SLAM II*), e.g., queues of various sorts, decision points, branching paths, and activities that impose time delays. Each icon has connectors around its periphery that can be used to link the icon to connectors on other icons. These connections permit the flow of items (or modeled entities) through the model. An item input connector, shown as ◘, indicates where an item enters an icon and an associated item output connector, shown as ◘, where an item

(usually the same one) exits the icon on its way to another icon further to the right. The entities might be customers passing through a bank as they are serviced by tellers, cars moving through phases of a car wash, or messages passing through processing nodes. A value input connector, shown as ▫, indicates that the icon can be provided with a parameter value and a value output connector, shown as ▪, allows an icon to make a value available to other icons. With rare exceptions, an item output connector is linked one-to-one to an item input connector on a nearby icon. And similarly the parameter connectors on nearby icons are linked to pass values back and forth, possibly using many-to-one connections. There is also a universal input connector, shown as ⭘, that will accept either a value or an item; however an input at this type of connector will simply be used as a boolean variable to determine some outcome, e.g. the result of a decision. That is to say: items that are available at a universal connector are not processed as they would at an item input connector; rather the existence or absence of an item at a universal connector is treated as a true/false event that can trigger some process within the icon.

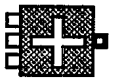
3. When an icon has determined the current value of a parameter, that value can be made available through a value output connector or provided through a dialogue box. Each icon has an associated dialogue box that permits interaction with the user of the model. At any point in the simulation, the user can double click on an icon to see its dialogue box. Each dialogue box has a combination of 'soft buttons' and text and numeric fields that permit the user to provide appropriate values to the icon, to read the current values that are in use, and to control some aspects of the process simulated by the icon. The dialogue box associated with the First In First Out (FIFO) Queue icon is shown here. Before running a simulation that uses this icon, a user may wish to



open the dialogue box and enter a value for the maximum length of the queue; the default value is 1000, as shown here. Once the simulation is in progress or at the conclusion of a run, the user can look to the dialogue box to determine the state of the queue, e.g., the average queue length, the average wait, and the utilization. While the simulation is running, the three value output connectors around the FIFO Queue icon can provide parameters of interest to other icons. The connectors marked L and W provide respectively the instantaneous queue length and the waiting time of the current first item in the queue (as long as the 'continuous' radio button in the dialogue box is selected). The connector marked F is zero as long as the queue is not full; it is set to 1 when the queue is full. The model designer can also provide comments in the dialogue box to assist the user. And the user can also use the help button to get more information (as shown) on how the icon works.

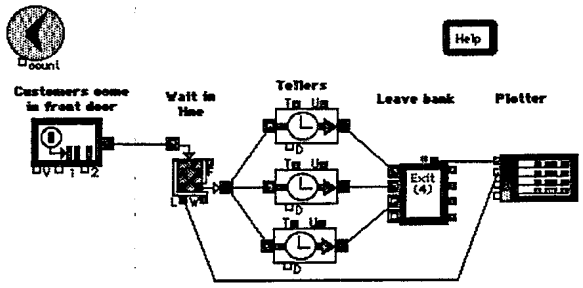


4. Icons can be of three types: discrete event icons, generic icons, and plotters. Discrete event icons, for example the FIFO Queue icon shown above, receive items from or send items to another discrete event icon; most do both. The icons in the generic library do not handle items—only input value and output value connectors are used, as in the Add icon to the right; these icons are used to manipulate parameter values and provide results. (The Add icon provides the sum of up to three input values at the output connector.) The plotter icons can take input from several output value connectors on other icons and then provide a graphical time history of those parameters' values over the course of the simulation.



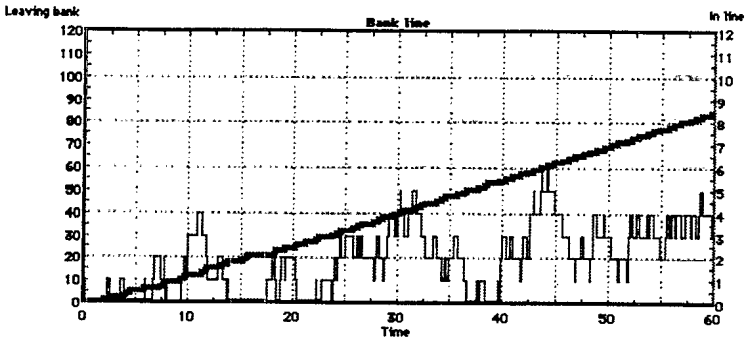
5. A completed model will look something like the diagram shown here. The 'clock-

face' icon in the upper left corner indicates that the model will use discrete-event constructs. Placing this icon in a model adds the necessary computer code to supervise the discrete event model, e.g., schedulers for the critical events. Below it is a Generator icon that creates customers (items) for a bank line simulation. The customers move to the right into a FIFO Queue icon where they 'wait in line'. A customer at the head of the queue moves to one of three tellers if they are not all busy; otherwise the customer will wait until one is available. Each teller will provide a service to a customer, and impose an appropriate delay. The teller is tied up during this delay period and customers may have to wait in the queue if all tellers are servicing customers. Once a customer has received the necessary service, he or she moves to the exit. The Exit icon, which incidentally will accommodate items exiting from up to four adjacent processes, provides an aggregate count of all of the items that have exited through the icon. It also can provide separate counts of items that exited through each of the four input item connectors along its left edge, although these are not used in this model.



6. These are all the icons necessary to run the model. However there are a couple of others that are included in the model diagram. On the right side of the model diagram is a plotter that shows the length of the queue (from the'L' value output connector on the FIFO Queue icon) and the total number of customers processed (from the connector marked '#' on the Exit icon). When the user double clicks on the plotter in this example, a graph like the one below will be displayed. The diagonal line in the graph shows the accumulation of serviced customers over a 60 minute period (using the left vertical scale). The jittery line shows the length of the queue over time (using the right vertical scale).

The last icon in the model (in the upper right of the diagram) is to provide help to the model user. If the developer is sufficiently thoughtful, he or she can put text into the dialogue box of this icon to help any model user to understand the purpose and the design of the model.

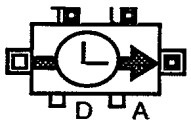


Annex B
To DMS Research Note 7/94
Dated September 94

AN ABBREVIATED GLOSSARY OF 21 EXTEND ICONS

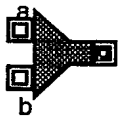
Discrete Event Icons

1. Activity, Delay: Holds an item for a specified amount of time, then releases it. The time delay can be specified in the dialogue box or by the value at the 'D' connector. An attribute of the item may provide the time delay.



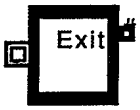
2. Activity, Hold: Holds an item until a specified time, then releases it. The hold-until time can be specified in the dialogue box or by the value at the 'H' connector. An attribute of the item may also provide the hold-until time.

3. Combine: Combines items from two different source flows into a single stream.

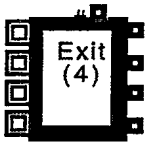


4. Executive: Controls the timing and passing of events. This icon is included in a model to indicate that it will use components of the discrete event library.

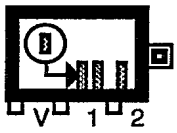
5. Exit: Takes items out of the simulation. A running total of items that have exited via this icon are provided at the connector marked '#'.



6. Exit, Multiple: Takes items out of the simulation from up to four sources. A running total of all items that have exited the model via this icon are provided at the connector marked '#'. Separate totals for each of the sources are available on the value output connector opposite the respective item input connector.



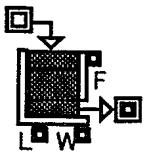
7. Generator: Injects new items into a simulation on a specified pattern. A variety of patterns is available in the dialogue box based on the distribution of inter-arrival times. The choices include constant, Poisson/exponential, normal, and random. Values of the parameters of the chosen distribution can be provided at the connectors marked '1' and '2', should it be appropriate.



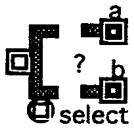
8. Get Attribute: Extracts and displays an attribute associated with an item. The value of the selected attribute of the current item is made available at the connector marked 'A'.

9. Information: Displays information associated with items that pass through it in its dialogue box. The attributes of interest can be selected in the dialogue box.

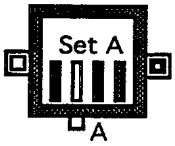
10. Queue, FIFO: Provides a first-in first-out queue. Items collect here until an icon to the right is free to process a new item. Then an item is passed from the start of the queue to the processing icon.



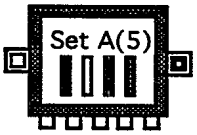
11. Select DE Output: Selects an output path based on the decision result provided at the connector marked 'A'. The correspondence between the value at 'A' and the path to be chosen can be set in the dialogue box.



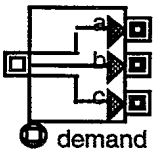
12. Set Attribute: Sets an attribute of the item passing through the icon. The value of an attribute can be set based on a value provided at the connector marked 'A'.



13. Set Attribute (5): Sets up to five attributes of the item passing through the icon based on values provided at the connectors across the bottom of the icon.

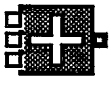


14. Unbatch: Generates several (1, 2, or 3) items for each single item that arrives.

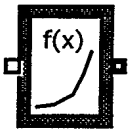


Generic Icons

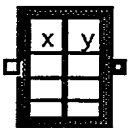
15. Add: Provides the sum, at the output connector, of up to three values at the input connectors.



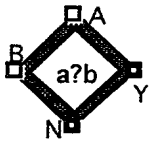
16. Conversion Function: Modifies the input value based on a mathematical function that is specified using the icon's dialogue box.



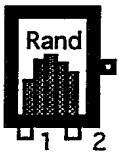
17. Conversion Table: Provides an output value based on the input value and the contents of a 'look-up' table.



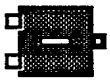
18. Decision: Provides a decision result based on the input values at 'A' and 'B' and boolean criteria set in the dialogue box.



19. Input Random Number: Generates a random number based on criteria set in the dialogue box. A side selection of distributions is available including uniform, normal, and exponential.



20. Subtract: Subtracts the value on the lower value input connector from the value on the upper value input connector and provides the result on the value output connector.



21. System Variable: Provides the current value of one of eight system variables as selected in the dialogue box. The most obvious use of this icon is to access the 'Current Time' in the simulation.

UNCLASSIFIED

SECURITY CLASSIFICATION OF FORM
(highest classification of Title, Abstract, Keywords)

DOCUMENT CONTROL DATA
(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (the name and address of the organization preparing the document. Organizations for whom the document was prepared e.g. Establishment Sponsoring a contractor's report, or tasking agency, are entered in Section 8).

DGOR/DMS
National Defence Headquarters
Ottawa, Ontario, K1A 0K2

2. SECURITY CLASSIFICATION
(overall security classification of the document, including special warning terms if applicable)

UNCLASSIFIED

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title)

Design of the Provisional EW Assessment Model

4. AUTHORS (last name, first name, middle initial)

Cameron, Frederick W.P.

5. DATE OF PUBLICATION (month Year of Publication of document)

September 1994

6a. NO OF PAGES (total containing information. Include Annexes, Appendices, etc.)

23

6b. NO OF REFS (total cited in document)

2

7. DESCRIPTIVE NOTES (the category of document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

DMS Research Note

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address).

DLR 4 & D Sigs EM 2, National Defence Headquarters, Ottawa, Ontario K1A 0K2

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)

24228-6

9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written.)

10a. ORIGINATOR's document number (the official document number by which the document is identified by the originating activity. This number must be unique to this document.)

DMS Research Note 7/94

10b. OTHER DOCUMENT NOS. (Any other numbers which may be assigned this document either by the originator or by the sponsor.)

---

11. DOCUMENT AVAILABILITY (any limitations on further dissemination of the document, other than those imposed by security classification.)

(X) Unlimited distribution
( ) Distribution limited to defence departments and defence contractors: further distribution only as approved
( ) Distribution limited to defence departments and Canadian defence contractors; further distribution only as approved
( ) Distribution limited to government departments and agencies; further distribution only as approved
( ) Distribution limited to defence departments; further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in 11) is possible, a wider announcement audience may be selected.)

13. **ABSTRACT** (a brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), or (U). It is not necessary to include here abstracts in both official languages unless the test is bilingual).

(U) The Land Tactical Electronic Warfare Equipment Project (L1246) is intended to provide the Canadian land forces with the electronic warfare (EW) systems that will carry them into the 21st century. The staff responsible for the project wanted a model of tactical EW that would permit the evaluation of various re-equipment proposals against the current capability. A provisional EW Assessment Model was produced as a first step towards developing a more comprehensive model. Although this paper on its own provides a sufficient description of the provisional model, it is intended to accompany a videotaped summary of the model. (U)

14. **KEYWORDS, DESCRIPTORS or IDENTIFIERS** (technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus-identified . If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Electronic Warfare
Modelling
Simulation
Communications ESM
Electronic surveillance measures

28/2

#147222

NO. OF COPIES NOMBRE DE COPIES	COPY NO. COPIE N°	INFORMATION SCIENTIST'S INITIALS INITIALES DE L'AGENT D'INFORMATION SCIENTIFIQUE
1	1	DAG

AQUISITION ROUTE / FOURNI PAR ▶ DMS

DATE ▶ 31 OCTOBER 1994

DSIS ACCESSION NO. / NUMÉRO DSIS ▶ 95-007 46

DND 1158 (6-97)

National Defence / Défense nationale

PLEASE RETURN THIS DOCUMENT TO THE FOLLOWING ADDRESS:

DIRECTOR
SCIENTIFIC INFORMATION SERVICES
NATIONAL DEFENCE
HEADQUARTERS
OTTAWA, ONT. - CANADA K1A 0K2

PRIÈRE DE RETOURNER CE DOCUMENT À L'ADRESSE SUIVANTE:

DIRECTEUR
SERVICES D'INFORMATION SCIENTIFIQUES
QUARTIER GÉNÉRAL
DE LA DÉFENSE NATIONALE
OTTAWA, ONT. - CANADA K1A 0K2

Canada