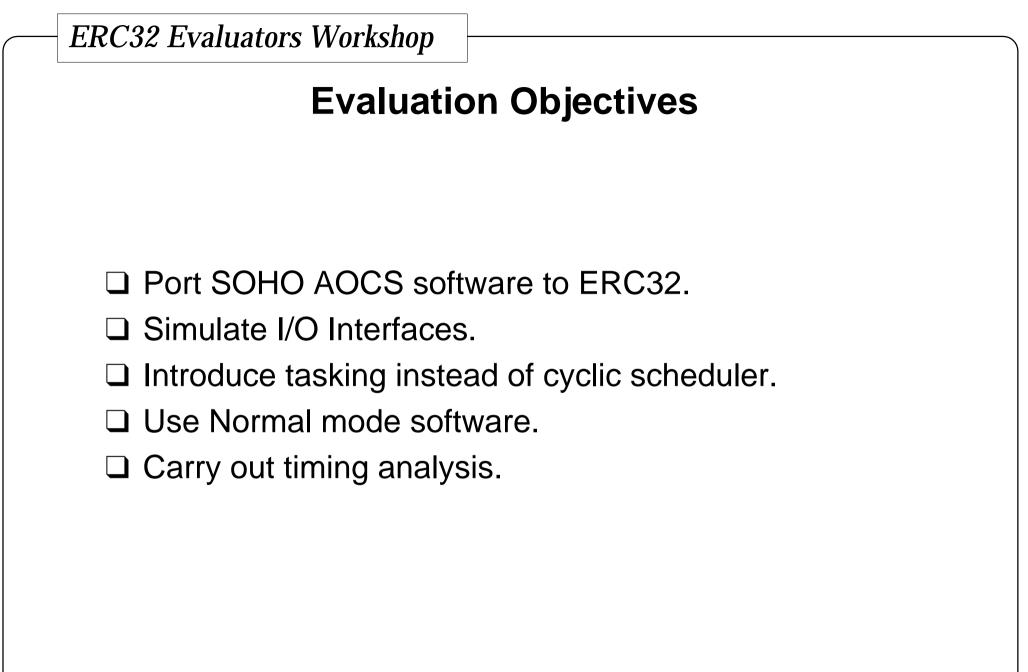


ERC32 SOFTWARE TOOLS EVALUATION

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Rationale

For:

□ a significant system (6000 lines of Ada).

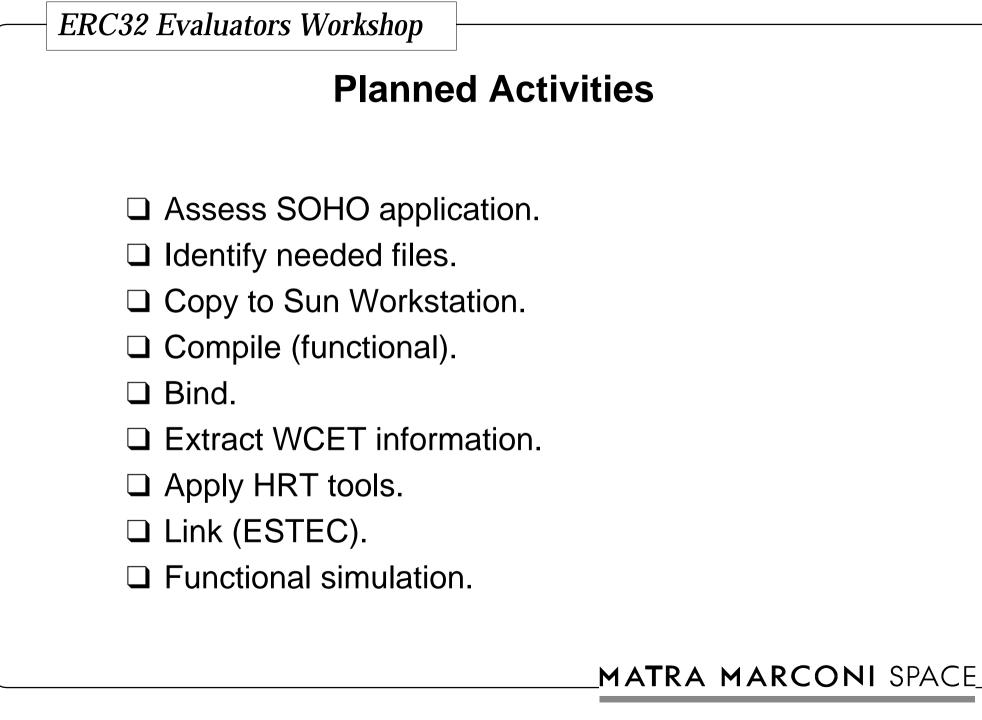
□ a working system, concentrate on tools.

□ real time properties important.

Against:

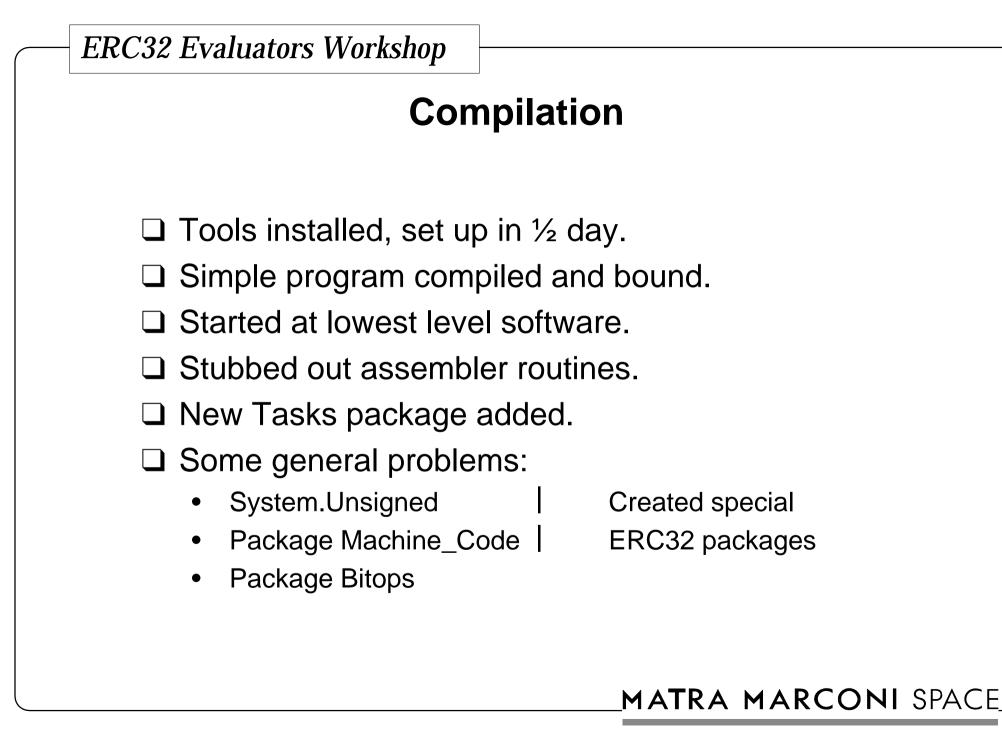
□ problems of porting code.

| ERC32 Evaluators Workshop | |
|---|---------------------|
| Time | escales |
| Planned: | |
| Start September | |
| Finish December | |
| Actual: | |
| □ September | |
| · | |
| illness missed training d | lay |
| January | |
| | |
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- □ Multiple modes.
- □ Each mode self contained.
- □ Frequency/phase scheduler.
- □ Mode change by table change.
- □ Choose Normal mode.
- □ Follow WITH chains to identify needed files (70 out of 120).
- □ FTP all needed files (VAX -> Sun)



Compilation (cont)

□ Some particular problems:

- Address calculations (e.g. TM buffers)
- Unchecked Conversions not allowed as assignment targets.
- Integer to/from Enumerated type conversions.
 - Implementation restriction why?
- Integer to/from Boolean type conversions.
- Long_Integer, Storage size.
- Unchecked Conversions with size differences.

Examples 1

Formatted_Torque

:= System.Unsigned(abs(Fix(Wheel_Torque(n) * Scale_Factor)));

declare -- local block to perform bit manipulation on Formatted_Torque

subtype Bit_Index is Integer range 0..15; MSB : constant Bit_Index := 0; type Boolean_Array_Type is Array (Bit_Index) of Boolean; Pragma Pack (Boolean_Array_Type); -- pack into one word function CUB is new Unchecked_Conversion

(Source => System.Unsigned, Target => Boolean_Array_Type);

begin -- set bit 7 of Formatted_Torque to sign of Wheel_Torque(n)

CUB(Formatted_Torque)(7) := (Wheel_Torque(n) < 0.0);</pre>

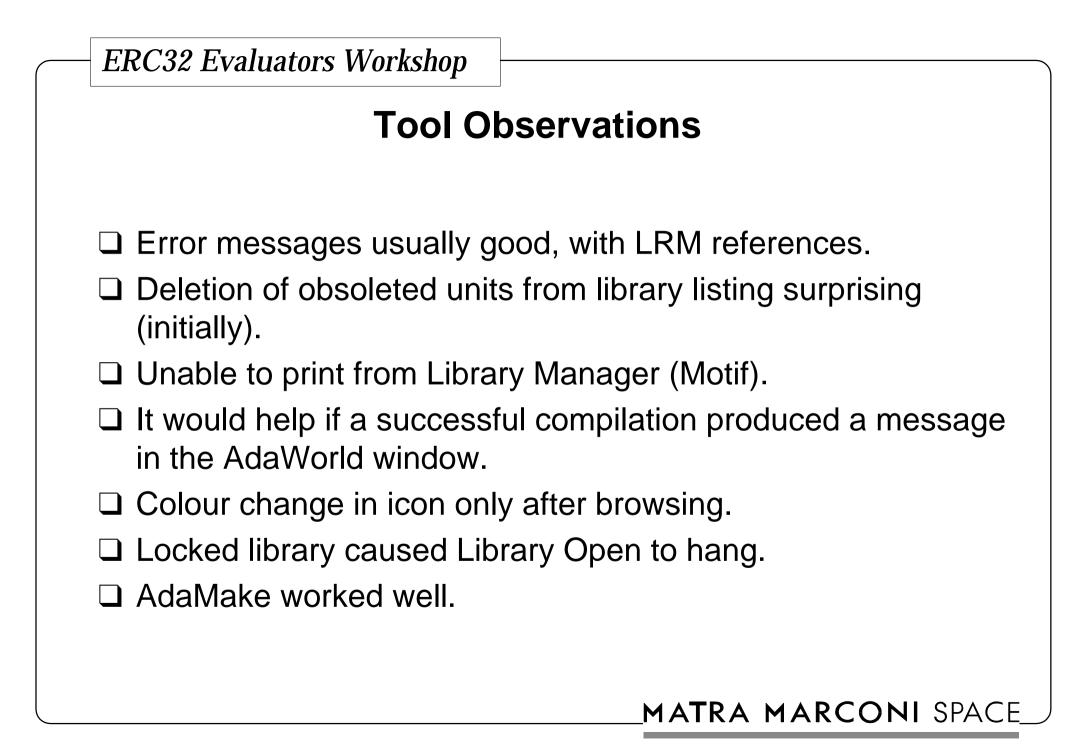
end; -- local block

Examples 2

```
type FPSS_Data_Error_Type is
        (OK, Bad_Ap, Bad_Ay, Bad_Angle_P, Bad_Angle_Y,
No_Sun_P, No_Sun_Y);
```

```
for FPSS_Data_Error_Type use (0, 1, 2, 4, 8, 16, 32);
--
function CFI is new Unchecked_Conversion
  (Source => FPSS_Data_Error_Type,
    Target => Integer);
```

```
function CIF is new Unchecked_Conversion
  (Source => Integer,
   Target => FPSS_Data_Error_Type);
Use of these functions flagged as an error
   MATRA MARCONI SPACE
```



Timing Data Extraction

Achieved successful Bind at functional level.

- □ Turned on WCET data in compiler options.
- □ Recompiled complete application.
- □ WCETE warnings in 8 files.
 - compound assignments.
 - pointers (access).
 - 'pos attribute.
 - loops with parameter for upper limit.
 - Raise statements (but there are none).
 - task declaration location.

Examples 3

352 MACS_Error_Data := (Counter => 0, Time => 0, First_Error => True);

353

354 On_Time_Increment := (others => 0); (array (1..8) of natural)
1

1 *COD WCETE subset warning: This construct is not permitted in the WCET Ada HRT Restrictions. The containing subprogram must not be called within the main body of a critical task.

2220 type Address_Pointer is Access ERC32_System.Address;

<--1-->

1 *EXP WCETE subset warning: This construct is not permitted in the WCET Ada HRT Restrictions. The containing subprogram must not be called within the main body of a critical task.

Examples 4

102 -- function Arctan(X : in Float) return Float is

103

104 begin

105

106 if abs(X) < X_Small then

107

108 return X;

1

2

1 *COD WCETE warning: Block containing explicit raise statement has been excluded from worst case path analysis.

2 *COD WCETE warning: Block containing explicit raise statement has been excluded from worst case path analysis.

Execution Profile generation

□ Enabled HRT processing in Binder.

□ First bind flagged errors in 3 procedures.

- Issue_RD in MACS object, undefined loop counts.
 Had to hard code no PRAGMA Loop_Count.
- Read_FPSS in AOCS_Units, a compound assignment. Rewrote as set of individual assignments.
 WHY IS THIS NOT DETERMINABLE BY COMPILER?
- Process_FPSS_Data in Sensor_Processing, a 'pos attribute. Replaced by Fixed value. ALL ATTRIBUTES?
- Obtained bindable system with 10 tasks, giving execution profile with 10 threads.

Timing comparison

Comparison between execution profile times and original SOHO calculated times:

| <u>Task</u> | <u>ERC32</u> | <u>SOHO</u> |
|-----------------|--------------|-------------|
| FPSS_Task | 5157 | 955 |
| Mode7_Ctl | 1134 | 400 |
| Control laws | 1989 | 4411 |
| Control laws HK | 2124 | 568 |
| Mode7 roll | 473 | 153 |
| SSU7 | 2280 | 2103 |
| SSU Data | 2408 | 3063 |
| SSU8 | 119 | 42 |
| RSL | 202 | 107 |
| Wheel | <u>2530</u> | <u>2160</u> |
| Total | 18416 | 13962 |

NB: ERC32 1MHz, SOHO MAS281 15MHz, 3 wait states

ERC32 Evaluators Workshop **HRT tools**

- □ Tools easily installed.
- □ Straightforward to run.
- □ UCF file generated from original scheduler table data.
- □ ESF file from compiler used.
- DEMO run time file used.
- □ Analyser shows thread set schedulable.
- □ GANTT chart generated from Simulator.

ERC32 Evaluators Workshop Conclusions Evaluation has been useful, given time constraints. □ Tools acceptable. □ Future directions: • ERC32? Yes Ada Compiler? Probably WCET extraction? Yes (standalone table of times?) • Functional simulation Yes HRT tools? ? (tasking vs frequency/phase) •