TO: PROF. C.A.R. HOARE, c/o RM 1219, TOKYO GRAND HOTEL.

FROM: STEPHEN MUGGLETON, c/o NORIKO NAMIKOSHI, ICOT,

TEL: 3456 3195

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1992

Japan trip.

DATE: 28TH JUNE,

DEAR PROF. HOARE,

I HAVE NOW FINALISED OUR SCHEDULE FOR NEXT WEEK.

MON. JUNE 1. FUJITSU EVENING MEETING. YOU HAVE A SEPARATE MEETING AT FUJITSU IN THE MORNING. IN THE EVENING WE WILL LEAVE FROM THE FGCS RECEPTION AT 6.30 P.M. DR. SATOH OF FUJITSU WILL BE THERE.

WED. JUNE 3. 10 A.M. MEETING [NIPPON STEEL] NORIO YOSHIDA, GENERAL MANAGER, SOFTWARE TECHNOLOGY CENTRE, NIPPON STEEL CORP., 31-1 SHINKAWA 2-CHOME, CHUO-KU, TOKYO 108. TEL: 5566-2071 FAX: 5566-6859. JOINT PRESENTATION ON REVERSE ENGINEERING. I HAVE A MAP TO GET THERE. I SUGGEST WE TRAVEL BY UNDERGROUND FROM DAIMON STA. TO HACHOBORI STA. (TOEI ASAKUSA LINE) FROM WHICH IT IS A FIVE MINUTE WALK. I WILL MEET YOU AT TOKYO GRAND HOTEL AT 8.45 A.M.

THU. JUNE 4. HITACHI MEETING. 10.30 A.M. MEET DR. Y. KUWAHARA, ACTING GENERAL MANAGER, CORPORATE R&D PROMOTION OFFICE, HITACHI LTD., SHIN MARU BIRU (NEW MARANOUCHI BUILDING), 5-1 MARUNOUCHI 1-CHOME, CHIYODA-KU, TOKYO 100. TEL: 3212-1111 FAX: 3214-3349 (HOME PHONE: 0426-26-2396). EXT. 2241 THE NEW MARANOUCHI BLDG. IS DIRECTLY IN FRONT OF TOKYO J.R. STATION ON THE IMPERIAL PALACE SIDE. DR. KUWAHARA'S OFFICE IS ON THE 7TH FLOOR. THE MEETING WILL BE FOR 1 HOUR (NO PRESENTATION). WE WILL HAVE A LIGHT LUNCH THERE. I SUGGEST WE TRAVEL BY UNDERGROUND FROM SHIBAKOEN STA. (NR. TOKYO GRAND) TO OTEMACHI STA. FROM WHICH THE NEW MARANOUCHI BLDG. IS 7 MINS. WALK. I WILL MEET YOU AT TOKYO GRAND HOTEL AT 9.00 A.M.

Collaboration between IBM, Hursley and PRG,Oxford

1981 - chance meeting between Prof. Hoare and IBM's CICS manager, Tony Kenny.

1982 - research contract established.

1992 - project wins Queen's Award for Technology.

What happened in between?
What has been achieved?

CICS
Customer Information Control System

o online transaction processing system originally developed in 1968

o used worldwide in banks, shops, airlines, insurance etc.

o supports large data-bases being accessed by many terminals

o over 800,000 lines of code

o new release every two years

Z

State-based specification language based on typed set theory.

The state of a system and operations on the state are represented by schemas. eg:

$$[Record, Key]$$

```
┌─ File ──────────────────────────
│  f : Key ⇸ Record
│
└─────────────────────────────────
```

```
┌─ Read ──────────────────────────
│  ΞFile
│  k? : Key
│  r! : Record
├─────────────────────────────────
│  k? ∈ dom f
│  r! = f k?
└─────────────────────────────────
```

```
11101000111001010001111010000011101010111001 0
01100110010010100011110100001011010100110010
0111000000100101000111101000011100000110010
10010100011101000111101000110010100011110 1
11101010001100001100101000111010010001100
10010100011101001011100110010010100011110 1
0110101100100101000111101010001101101001001 0
11101010000111000001100101000111101010000 1110
11100010111001010001110101000111001010010010
10010100011101010001110111000100101000111101
10010100011101010010111000000100101000111101
11101010011110010011001010001111010100111100
0110110000100101000111101010100110010001001 0
11101010101110000100100101000111101010101110 0
1001010001111010101011100110001001010001111 01
0110110000100101000111101010100110010001001 0
11101010101110110011001010001111010101011110
1001010001111010101011110010111001010001111 01
11101011000110000011001010001110101100011 00
1110101100011011100100101000111101011000111 0
11101100010110001011100101000111011000101100
10010100011110110010011010100010010100011110 1
10010100011110110011111001001100101000111101
11101101001100100011001010001111011010011100
11101110001110000110010100011101110000111 0
11101110010110111011100101000111011100111 00
11100000010010100011101110101110000011100 10
11101110101110001011001010001110111010111 00
10010100011110111010111100100010010100011101
10010100011110111011011100100010010100011101
0110011000100101000111101110001101000111001 0
10010100011110111100111100100010010100011101
```

CICS ESA V3.1.1 became generally available in June 1990.

268,000 lines of new or changed code
of which
37,000 specified in Z
11,000 partially specified in Z

plus
500,000 lines of old code

Subjective results

Designers and developers were
generally in favour of Z.
They felt:

- o schemas improved document structure

- o using Z also improved the prose

- o more confident of the correctness of their
  code.

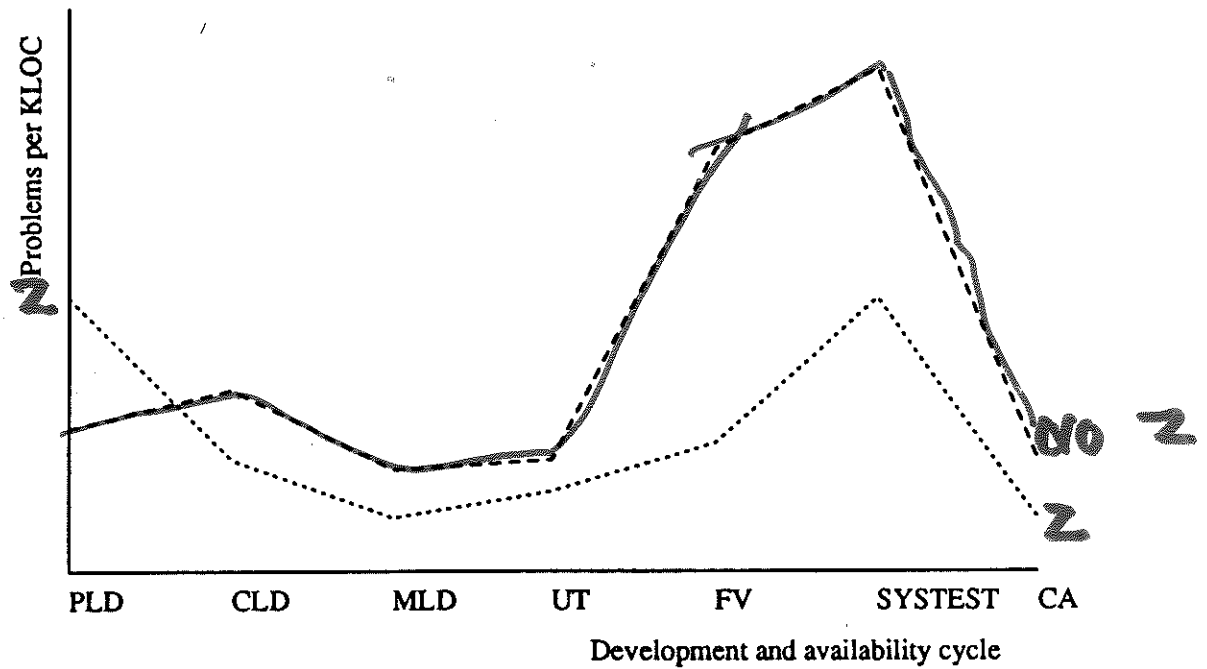Earlier stages took longer.
Coding was faster.

Qualitative results

Measurements taken throughout development process.

Not specifically designed to assess the use of Z.

Possibility of different interpretations/ criticisms.

KEY

··········	Z specified code	UT	Unit Test
- - - - - ·	Non-Z specified code	FV	Functional Verification
PLD	Product Level Design	SYSTEST	System Test
CLD	Component Level Design	CA	Customer Availability
MLD	Module Level Design		

Figure 2: Comparison of problems found with two development methods in CICS/ESA V3.1

Oxford / IBM Collaboration

Save $5M development cost

Double quality of delivered code

Z standard and tools

Clean Room

$10 \times$ quality project.