Preface

In a number of recent presentations – most notably at FME'96[1] – one of the foremost scientists in the field of formal methods, C.A.R. Hoare, has highlighted the fact that formal methods are not the only technique for producing reliable software. This seems to have caused some controversy, not least amongst formal methods practitioners.

How can one of the founding fathers of formal methods seemingly denounce the field of research after over a quarter of a century of support? This is a question that has been posed recently by some formal methods skeptics.

However, Prof. Hoare has not abandoned formal methods. He is reiterating, albeit more radically, his 1987 view[2] that more than one tool and notation will be required in the practical, industrial development of large-scale complex computer systems; and not all of these tools and notations will be, or even need be, formal in nature.

Formal methods are not a solution, but rather one of a selection of techniques that have proven to be useful in the development of reliable complex systems, and to result in hardware and software systems that can be produced on-time and within a budget, while satisfying the stated requirements.

After almost three decades, the time has come to view formal methods in the context of overall industrial-scale system development, and their relationship to other techniques and methods. We should no longer consider the issue of whether we are "pro-formal" or "anti-formal", but rather the degree of formality (if any) that we need to support in system development. This is a goal of ZUM'98, the 11th International Conference of Z Users, held for the first time within continental Europe in the city of Berlin, Germany.

How formal should the system development process in industry be in practice? The answer to this is likely to depend on the organization concerned, and even within an organization with consideration of the project in question, the personnel involved, standards that must be satisfied, and many other issues. Clearly valid answers range from "completely informal" to "full formal development". It might be thought as software development moves towards being a fully fledged engineering discipline that increasingly the answer would tend more towards the latter; unfortunately that is not necessarily the case.

How much formality should we be introducing to our students? At this stage in the evolution of formal development methods, it might be hoped that the answer to this would be rather uniform. Surprisingly, the range of answers is diverse, ranging from "none" to "a large amount of formality". This diversity is of great concern. Surely we should be united and agreed on the level of formality

[1] C.A.R. Hoare, How did software get so reliable without proof?, Springer-Verlag, *Lecture Notes in Computer Science*, **1051**:1–17, March 1996.

[2] C.A.R. Hoare, An overview of some formal methods for program design, *IEEE Computer*, **20**(9):85–91, September 1987.

to which our students need to be introduced so that they are prepared for future research and industrial practice? Again, this is not the case, although we argue here that it should be: for formal methods to become routine in appropriate development environments and scenarios, we require a skilled workforce that can bring concepts and ideas from academic investigation into realistic (industrial) development processes.

While not everyone involved in the software development process needs to be a formal methods expert, a certain minimum appreciation of formality and underlying mathematics is required by all involved in system development. An Educational Issues Session, organized by Neville Dean, and run as part of this conference, addresses these and other issues.

Our invited speakers for ZUM'98 are drawn from Germany, the UK, and the USA, both from industry and academia. Klaus Grimm of Daimler-Benz AG opens the conference with a discussion on the industrial requirements for the efficient development of reliable embedded systems. He is responsible for all research work carried out at Daimler-Benz AG in the area of software engineering. Ib Sørensen of B-Core (UK) Limited is a leading promulgator of formal methods technology and was the original instigator of the first ever Z User Meeting in December 1986 at Oxford University. Nancy Leveson of the University of Washington, USA is well-known for her work in the area of safety-critical systems, including the application of formal methods where appropriate. Ernst-Rüdiger Olderog at the University of Oldenburg, Germany has research interests concerning the development and application of formal methods to the design of correct systems. His contributions include work on semantic models and their combination, formal specification with associated verification techniques, and transformational design.

Tool demonstrations are being organized by Wolfgang Grieskamp (Technical University of Berlin) throughout the main meeting. In addition, there are associated activities both before and after the main meeting. Tutorials are being organized beforehand, by David Till, City University, UK. In the afternoon after the end of the main conference, the 4th in a series of associated Educational Issues Sessions is to be held, organized by Neville Dean of Anglia Polytechnic University, Cambridge, UK as in previous years.

The location of ZUM'98 has been influenced by the active use of Z in industry and academia in Berlin. The conference is organized by the Z User Group, but is generously aided and supported by a number of organizations, many based in Germany. The cooperation of Daimler-Benz AG, GMD (the German National Research Center for Information Technology) and the Technical University of Berlin has been extremely helpful in the local organization of the event. The event is being held within the Technical University of Berlin. Wolfgang Grieskamp has been especially helpful in the coordination of the local organization, and deserves a special vote of thanks.

Daimler-Benz AG (Germany) has provided substantial financial support. Praxis Critical Systems (UK) continues to provide a valuable and appreciated service in the running of the Z mailing list. FACS, the Formal Aspects of Com-

puter Science specialist group of the British Computer Society (BCS), supports the Z User Group by providing publicity for meetings to its members.

This is the first time that we have been able to accept all contributions to the proceedings in electronic form suitable for processing using the LaTeX 2_ε document preparation system. As a result we have been able to publish the proceedings in a more uniform style than has previously been possible and an electronic version will be made available. On-line information concerning the conference is available under the following URL (Uniform Resource Locator):

`http://www.fmse.cs.reading.ac.uk/zum98/`

This will be kept up to date after the conference with any relevant information, and provides links to further on-line resources concerning the Z notation such as other Z User Meetings and formal methods in general.

Reading, Berlin and Omaha
July 1998

Jonathan Bowen, Andreas Fett
(Programme Co-Chairs)
Mike Hinchey
(Conference Chair)

Programme Committee

The following people were members of the ZUM'98 programme committee:

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Jonathan Bowen, The University of Reading, UK
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Neville Dean, Anglia Polytechnic University, UK
John Derrick, The University of Kent at Canterbury, UK
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Andy Evans, University of Bradford, UK
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Henri Habrias, University of Nantes, France
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Norah Power, University of Limerick, Ireland
Alf Smith, DERA Malvern, UK
David Till, City University, London, UK
Sam Valentine, University of York, UK
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Jim Woodcock, Oxford University, UK
John Wordsworth, IBM Hursley UK Laboratories, UK

* Those marked with an asterisk also helped with the local organization under the leadership of the local coordinator, Wolfgang Grieskamp.

External Referees

We are grateful to the following people who aided the programme committee in the reviewing of papers, providing additional specialist expertise:

Michel Allemand, University of Nantes, France
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Kirsten Winter, GMD FIRST, Germany

Sponsors

The 11th International Conference of Z Users greatly benefited from the cooperation and sponsorship of the following organizations:

Daimler-Benz AG
GMD FIRST
Technical University of Berlin
Praxis Critical Systems

Tutorial Programme

The following tutorials were scheduled on the day prior to the main conference (23rd September 1998):

Developing Safety-Critical Embedded Systems: The ESPRESS Approach
Wolfgang Grieskamp, Maritta Heisel, Thomas Santen, and Matthias Weber, The ESPRESS Project, Germany

Effective Use of Z/EVES
Mark Saaltink, ORA, Canada

Educational Issues Session

The following informal talks were presented at a half-day session held immediately after the conference (26th September 1998):

What and How to Teach

Z on the Web
Jonathan Bowen, The University of Reading, UK

Mental models of Z
Neville Dean, University of East Anglia, UK

What makes a good specification case study? (Panel Discussion)
Norah Power, University of Limerick, Ireland

Assessment Issues

Collaborative work to answer a test on formal specification in B
Henri Habrias, University of Nantes, France

Managing Z coursework on-line
Zarina Shukur, Edmund Burke, and Eric Foxley, University of Nottingham, UK

Poster

ZUM'98

11th International Conference of Z USERS

DAIMLERBENZ
AKTIENGESELLSCHAFT

Praxis Critical Systems

Organized by the Z User Group,
In cooperation with Daimler-Benz Research Berlin,
GMD FIRST and TU Berlin

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BCS FACS

24-26 September, 1998
Berlin, Germany

Conference
Tool demonstrations
Educational Issues Session
Tutorials

Invited speakers:
Dr. Klaus Grimm (Daimler-Benz AG, Germany)
Prof. Nancy Leveson (University of Washington, USA)
Prof. Dr. Ernst-Rüdiger Olderog (Universität Oldenburg, Germany)
Ib Sørensen (B-Core (UK) Limited, UK)

GMD FIRST

- **Z standardization and foundation**
- **Z and reactive systems**
- **Z specification methodology**
- **Z on the web**
- **Combining Z with SE techniques**
- **Z applications**

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On-line and up-to-date conference information may be found under:
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