The Mainframe Lives and Thrives

THE MAINFRAME LIVES

By Dr Terry Critchley

There is a story that must be told since it uncovers an injustice visited upon a piece of information technology (IT) equipment called a mainframe computer. These, like many such situations displaying bigotry and ignorance, are put forward by people who do not understand the butt of their criticism.

There is a word for this type of person's traits: '*Ultracrepidarianism is the habit of giving opinions and advice on matters which one knows nothing abou';* The word first appeared as an insult in an 1819 letter by essayist William Hazlitt. [from Howtogeek].

I decided that, since few outside IBM will would take up swords on the mainframe's behalf, I would do it to the best of my ability. I did spend nearly a quarter of a century with IBM, much of it with customers who had mainframes.

I should say at this juncture that I have no connections with IBM except those of a normal retiree.

Short History of the Mainframe

In the 1960s, when IBM was in its prime, there was no definition of a 'mainframe' except it was a term applied to larger machines, usually one, which served large companies and were accessed using 'dumb' terminals. Their claim to intelligence was a data buffer which was built up to completion before being sent to the computer for processing, plus a few other built-in communication functions. The term mainframe eventually became synonymous with large IBM systems, sometimes called *big iron*, *big 'mippers'* and *big burners*.

Very dumb terminals, like to old DEC VTxx did not buffer keyboard input and when a character was typed, it went to the computer and back before it appeared on the user's screen; a 'feature' called echoplexing. If the communications line was busy, character appeared on the screen ages after typing by which time the user had typed 10 more before seeing anything!

IBM Mainframe Birth (1964)

Prior to this significant event, IBM (and others) sold a variety of systems, many aimed at a certain computing need and one type cold not run programmes from another type or communicate effectively. A company might own a computer for commercial work and another for scientific work, perhaps more than one of each.

In April 1964 IBM announced the System/360 range of compatible computers, so-called because it covered both scientific and commercial computing, that is, across 360° of the compute spectrum. IBM effectively 'bet its business' on the success of the S/360 after spending a borrowed \$5 bn. on its development. The rest is history.

The architecture of the /360, not the technology, was carried forward with enhancements through succeeding mainframe generations and it was IBM's proud boast that programme written for /360 would run on its successors. These included the 308x, S/370 (1970), 308x, 3090 and ES/9000 ranges, culminating in today's (2020) z series.

Mainframe Family Tree
https://www.ibm.com/ibm/history/exhibits/mainframe/mainframe_FT2.html

There were, as in all products, imitators, one of which was the Amdahl systems which were IBM 'look-a-likes', developed by Gene Amdahl, an ex-IBM /360 mainframe developer. There were others, like the Japanese equivalents, which emerged to compete with IBM. These were the *mainframe wars*, a precursor to the *UNIX wars* a decade or so later. Many smaller systems came and went, for example, Itel (*sic*), Sequent, Prime and DEC VAX.

System 360; From Computers to Computer Systems
https://www.ibm.com/ibm/history/ibm100/us/en/icons/system360/

Mainframe Memories

I remember much of the post-/360 era with nostalgia, not just for the technology but for the team spirit and humour.

1. I remember going into customer site one day and hearing a fairground-like rendition of 'She'll be coming round the mountains ….'. Odd, I thought and odder it seemed when I found the sound was being generated by the computer's printer, driven by a special programme written by the IBM engineers. I have since been told of other musical computer machines, even calculators.
2. I configured the microcode for a dual printer setup for a public utility one year and rang in to ask how they were performing. They told me they were functioning but printing alternate lines of a utility bill on a different printer!
3. This notice, often found attached to mainframes is one abiding memory of them.

ACHTUNG

ALLES LOOKENSPEEPERS,

DER COMPUTENMASCHINE IST NICHT FUR GEFINGERPOKEN UND MITTENGRABBEN. IST ISCH EAZY SCHNAPPEN DER SPRINGWERKE, BLOWENFUSEN UND DER POPPINKORKEN MITZ SPITZEN SPARKEN. IST NICHT FUR GEWERKEN BY DAS DUMMKOPFEN. DAS RUBBERNECKEN SIGHTSEEREN KEEPEN DAS HANZ IN DAS POCKETS. RELAXEN UND WATCH DAS BLINKENLIGHTS.

Zafety Noticen

Figure 1: Mainframe Handling Instructions

Modern Mainframe Myths

I meet and read about non-computer people (the IT-unwashed) who think the world's business is run on PCs and PC-like computers. Not only that, they believe there is such a

thing as a *computer expert*, who is a person who has learned to code or an eight-year old who is a whizz on an iPhone or PC. This is the apex of disillusionment.

It is therefore understandable that they will never conceive that the mainframe runs a significant part of their lives, since their misunderstanding is perpetuated by current science computer courses, the media and politicians. This misunderstanding will be corrected in this paper; whether the non-believers will recant is open to question. The facts I present will, however remain and, as Aldous Huxley noted:

'Facts do not cease to exist because they are ignored.'

The mainframe not only lives, it is the most reliable and cost-effective way of running large scale commercial computing.

Mainframe Issues

The mainframe does have one serious drawback; not in itself but in the lack of people to develop on and support it. When I joined IBM, full training was given to me and others; 19 weeks of computer training, one week of industry training and an edict to continue training for 22 days in each year. Today, I am told that people joining a computer company are given a company induction, a day or two about their computing and sent out into the field. Many of them are cut down when taken out of their narrow sphere of knowledge.

To cut a long story short, there is a dearth of mainframe education and training, though IBM does some good work via its *Master the Mainframe* initiative. The other downside is the rapid rate of retirement of old mainframe people, creating a double whammy for the mainframe support.

Incidentally, there is also a lack of training on important computing techniques such as Project Definition, Delphi Technique, SWOTs analysis and a dozen other methods of developing IT projects. Project management is quite well covered but is useless if the initial project specification, as developed by these techniques, is flawed.

Anatomy of the Mainframe

What follows are a number of myth-busting facts about the mainframe ecosphere, culled from various sources too numerous to list here. If threatened with jail in the Tower of London, I can retrace my research steps and reproduce them.
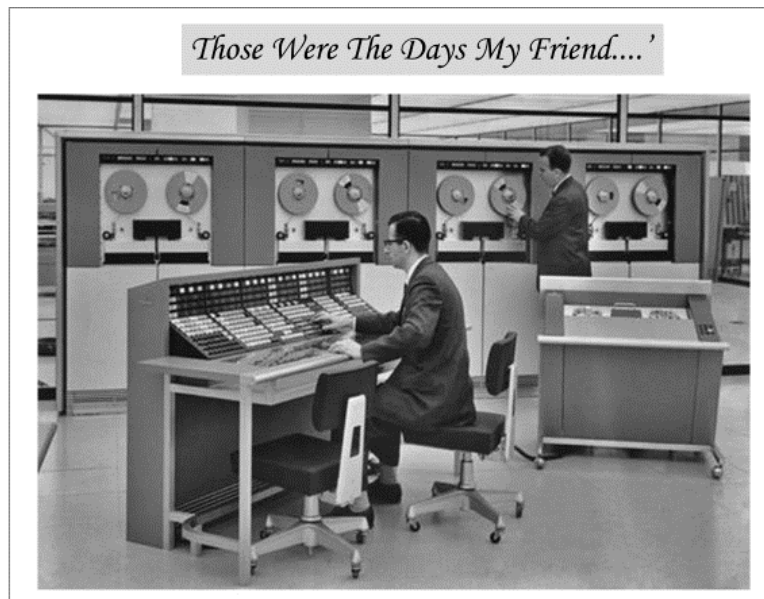
The IT-unwashed View of Mainframes

Figure 2: The View of the Mainframe

- They are old, along with their software and peripherals and are deemed *legacy* or *heritage*, along with the pyramids and Stonehenge
- They only support old, dumb terminals for access to systems
- They are totally inflexible and cocooned from modern technology
- They are cloud unfriendly, a bad trait today
- They are expensive to purchase run, slow to develop on, lack development agility and, in a word, use 'old hat' technology
- Their use in the workplace is dwindling fast and has been for years
- They don't support Windows or Linux
- Nobody wants to work on them
- Mainframe jobs pay peanuts compared with modern 'trendy' jobs
- All work is moving to the cloud environment and they run anything but mainframes.
- In essence, it should be consigned to the dustbin of IT history and a model preserved in a museum somewhere, along with wax models of the old geeks who worked on them.

Joining IBM on mainframes was the best decision I ever made.

Figure 3: An IBM Mainframe Person

These are myths, gathered by me from a Google search on 'mainframe myths' but the links are too numerous to list here. Below, are the facts about this 'electronic corpse'.

Today, mainframes run on, support or have:

- It is the most reliable and resilient piece of computer hardware on the planet, complemented by its software; Z series and LinuxONE hardware and an array of software between them are second to none in providing high availability and resilient computing
- The above is necessary when you look at the list of major companies which rely on the mainframe for their business
- 87% of all credit card transactions
- 30 billion transactions per day
- Nearly $8 trillion per year
- 29 billion ATM transactions per year (95% of them)
- 92 of the top 100 banks
- 23 of the 25 top airlines
- 23 out of 25 top US retailers
- 10 of the world's top 10 insurers, 84% of Top 25 Insurance Organizations
- 71 percent of Fortune 500 companies (355 out of 500)
- More transactions per day than Google searches (1.3 million/second on CICS transaction processing system vs. 68,542/second on Google)
- 55% of all enterprise transactions
- 80% of the world's corporate data originates on them
- 72% of firms noted their customer-facing applications are completely or very reliant on mainframe processing
- Handle 68 % of the world's production IT workloads, yet they account for only 6 % of IT costs.
- IBM's Z series mainframe sales are up 70% year-over-year (2018 on)
- Mainframe workloads are increasing; 57% to 64% mainframe usage (2017).
- 90% of all mainframe applications will be running in 2023
- For larger workloads, the mainframe is the most cost-effective system
- They are used today by cloud vendors in their offerings
- Mobile users each perform about 37 transactions daily and 91% of their apps communicate via the mainframe.
- They have the extra 'muscle' -equal to 1500 or more x86 systems - to handle increasing volumes of remote devices without resorting to multiple servers with their attendant costs
- They still have an emphasis on RAS (reliability, availability, serviceability) for mission critical workloads
- It supports Linux OS and modern programming languages such as Python, Java, JavaScript, and C++.
- The data centre lives too and rumours of its demise in favour of the cloud are somewhat exaggerated. See the section *Career Aspects & Prospects* later on the dangers of throwing the baby out with the bathwater.
- *Many data-center workloads staying on premises, Uptime Institute finds* https://www.networkworld.com/article/3569180/many-data-center-workloads-staying-on-premises-uptime-institute-finds.html

- You don't need the old, dumb 3270 screens to access it
- The mainframe today can take part in all the 'technology races' and is not simply a lonely COBOL silo, surviving on memories of the 'great days'
- Despite all this, few, if any, computer science courses even acknowledge the existence of the mainframe, let alone teach anything about it.

"Why don't you care about such a thing [mainframes]? Because you've been taught not to. Schools teach you that mainframes don't matter, if they are mentioned at all. Well guess what! Not only do they matter, everything you do, your family does, your government does, relies on them." [*quotation from a mainframe article 2015*]

Let's Boot the Mainframe Out!

The paper below talks of the value to business of their legacy systems and why the 'rip out and replace' is not a real option.

'For most established enterprises, core data and services that serve as the heart and lungs of the business are siloed within legacy systems. Legacy modernization refers to the process of adapting these older legacy systems to support modern business and technology needs.'

How APIs Can Modernize Legacy Systems
https://resources.lightwellinc.com/hubfs/downloads/Mulesoft/WP-Mulesoft-How_APIs_Can_Modernize_Legacy_Systems.pdf

COBOL – Dead as Latin

Nobody Knows COBOL

'The COBOL programmers' Facebook page counts over 14,400 members, and it continues to grow. Dice, the employment site, has 4,000 COBOL specialists and another 8,000 who have some experience with the language, according to Paul Farnsworth, chief technology officer of DHI Group, Dice's parent company. Many of today's COBOL programmers are cross-trained in Java; cloud systems, including Microsoft Azure and Amazon Web Services; and XML. ……

.. modern COBOL is even easier to learn, which is another reason why Conway says COBOL code isn't going anywhere. It supports many of the language features from C# and Java, and can run directly on .NET and Java platforms (compiling to respective byte code representations). "This allows in-process mixing of languages, and the ability to naturally exploit the power of these ecosystems. It's also fully backward-compatible with old COBOL.'

Why enterprises are adapting their COBOL apps vs. ditching them [a telling document]
https://techbeacon.com/app-dev-testing/why-enterprises-are-adapting-their-cobol-apps-vs-ditching-them

COBOL is used worldwide:

A report from Reuters in 2017 yielded the following jaw-dropping statistics:
- There are 220 billion lines of COBOL code still in use today.
- COBOL is the foundation of 43 percent of all banking systems.
- Systems powered by COBOL handle $3 trillion pieces of daily commerce.
- COBOL handles 95 percent of all ATM card-swipes.
- COBOL makes 80 percent of all in-person credit card transactions possible.

The Career Aspects & Prospects

- Average starting salaries for mainframe developers are 44% higher than other college graduates
- 10,000 'baby boomers' leave IT each year, leaving a mainframe skills gap
- There are expected to be over 37,000 mainframe admin positions in 2020 (US), 85,000 worldwide.
- In 2018, Glassdoor listed over 6,380 U.S. "mainframe" jobs and Indeed listed 9,675 jobs in mainframe, COBOL, z/OS, JCL, CICS, IMS.
- Based on current growth patterns, IBM predicts that approximately 37,200 new mainframe administration positions will emerge worldwide by 2020.
- The mainframe platform enables you to work on networking, analytics, databases, deep programming languages, APIs — the full 360 degrees of IT.
- The area of mainframe computing is wide and varied. There is no other area of computing that has the broad spectrum of computing aspect which can provide a satisfying, fulfilling career with prospects for job changes and, importantly, promotion. Can anyone imagine basing a career on a single aspect of IT, say artificial intelligence (AI) and writing algorithms from age 21 to retirement at 65 or older?

The Microfocus report below skewers the idea that if you have a mainframe running COBOL applications, you are dead or dying in the new world of the internet, when applications and all that new 'shiny' stuff. It shows in the results form a survey that:

- 92% of respondents see their COBOL applications as *strategic*[1]
- 53% plan to modernise their systems/application
- 71% considered modernisation as the best option for business change

This means running with the strategic and often business critical applications and not scrapping or rewriting in Python or Java.

Anyone that understands the large companies who live by many COBOL applications vital to their business will know that risking a conversion/migration/rewrite for them is asking for trouble. See the trouble that TSB (UK Bank) got themselves into when migrating critical applications *in the same form* from one system to another.

Anyone who doesn't understand large companies, will trot out the myths I have outlined above, that is, until somebody says to them; '*OK, draw up a plan for migrating our COBOL systems to the 'modern' stuff and carry the can for any losses we incur if it doesn't work*.' Estimates on this task predict many millions of dollars and very high risk (see the 'ditching' article above).

Modernization: Reimagining COBOL Systems for the Digital Age
https://www.microfocus.com/media/brochure/modernization-reimagining-cobol-systems-for-the-digital-age-brochure.pdf

… and despite the fraught Coronavirus situation;

COVID-19 unemployment claims up demand for COBOL programmers
https://searchapparchitecture.techtarget.com/news/252481881/COVID-19-unemployment-claims-up-demand-for-COBOL-programmers

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[1] In short, here to stay.

Visual COBOL (Microfocus)

A 'high octane' COBOL with numerous 'modernisation' features.

- Compile COBOL applications to Java
- Compile COBOL applications to .NET
- Fully featured COBOL editor
- Native code generator (various OSs)
- Mixed-language support
- Integrate COBOL with C/C++, C#, VB.NET, Java, and more
- RDBMS support

    Visual COBOL includes RDBMS support for Oracle, Microsoft, IBM, and open source databases, including PostgreSQL

- Support for virtualized, container, and cloud environments
- Advanced diagnostics tools

Future-proof your COBOL Business Applications
https://www.microfocus.com/en-us/products/visual-cobol/overview

The Modern Mainframe

The standard bearer for the mainframe today (2H 2020) is the IBM z series, which is supported by z/OS (grandson of MVS) and Linux together with a raft of software to round out the z series as offering *business solutions* and not simply a *collection of products*. It is definitely not an old mainframe with a new coat of paint; it has radical new features whilst retaining its compatibility with older models of mainframes.

Z Features

A single z series (z15) is about the size of a stand-up refrigerator, compared with the large real estate (tennis court) of the older mainframes and their control equipment. There are also orders of magnitude greater in numerical aspects like memory, power, storage, throughput and other entities. In particular, the RAS (reliability, availability, serviceability) introduced in early mainframes remains, but in advanced form in modern mainframes.

I shouldn't tell you this but years ago, IBM was divided in DSD (data systems division – large systems) and GSD (general systems division – smaller systems) and there was friendly rivalry between them. However, behind GSD's backs, DSD called them the *toy factory*.

Mainframers are a proud race with good reason to be so.

IBM Z15

Z15 Features

- Pervasive encryption, even across hybrid cloud
- Up to 40 TB memory
- Up to 190 cores
- Forward Error Correction
- 'Instant' recovery
- High availability and resilience
- Mind-boggling performance

The *pervasive encryption* feature is an interesting aid to security. It has been found that less than 3% of all data breaches or other cyber damage occur on encrypted systems.

In summary, the z15 mainframe and its siblings, z13 and z14, are the incredible hulks of the computing world whilst having the strength of Popeye, the speed of Usain Bolt, plus the good looks of the late Muhammad Ali, making them '*The Greatest*' for heavy-lifting work.

IBM Z Systems
https://www.ibm.com/it-infrastructure/resources/tools/z-mainframe-product-comparison/

The Teak Tough Mainframe

'Mainframes are also resilient when it comes to disaster recovery. Santalucia told the story of an insurance company located in lower Manhattan, within sight of the East River. The company operated a large data center in a basement that among other things housed a mainframe backed up to another mainframe located in Upstate New York. When Hurricane Sandy hit in 2012, the data center flooded, electrocuting two employees and destroying all of the servers, including the mainframe. But the mainframe's workload was restored within 24 hours from the remote backup.

The x86 machines were all destroyed, and the data was never recovered. But why weren't they also backed up?
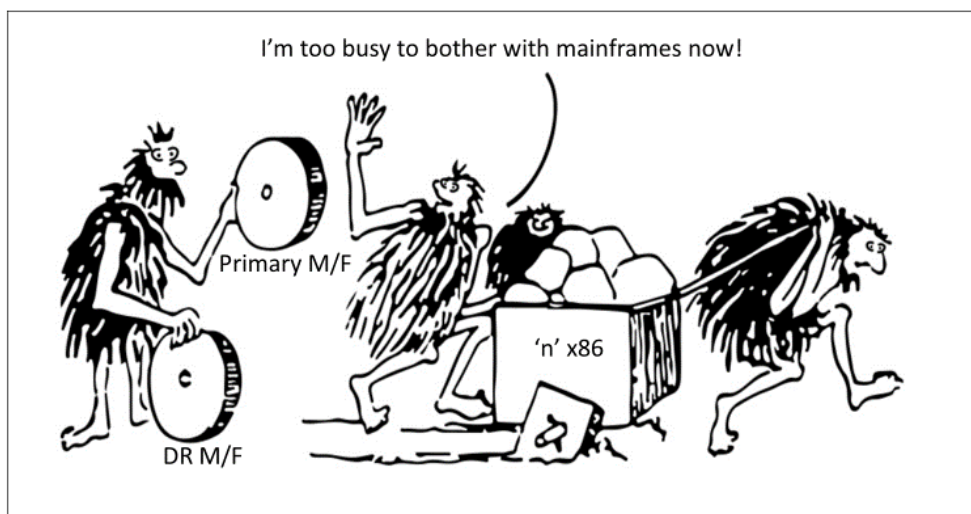

Figure 4: Tells its Own Tale

"The reason they didn't do this disaster recovery the same way they did with the mainframe was because it was too expensive to have a mirror of all those distributed servers someplace else," he explained. "With the mainframe, you can have another mainframe as an insurance policy that's lower in price, called Capacity BackUp, and it just sits there idling until something like this happens."

Mainframes are also evidently tough as nails. Santalucia told another story in which a data center in Japan was struck by an earthquake strong enough to destroy all of its x86 machines. The center's one mainframe fell on its side but continued to work.'

Why Mainframes Aren't Going Away Any Time Soon

https://www.itprotoday.com/hyper-converged-computing/why-mainframes-arent-going-away-any-time-soon

The mainframe comes into its own financially when you consolidate some 20-30 x86 servers, as the reference link above tells us along with others.

Comments by Terry Critchley

The conclusion of many papers, often quoting CIOs, is that lack of mainframe talent is threatening to damage their business and that there is no adequate education 'feeder' source to satisfy demand for 'mainframers' (See the Appendix for an IBM education initiative). This is perfectly understandable given that few, if any computing courses worldwide even mention the mainframe, let alone talk about it.

> *This I feel is disingenuous and does students and the commercial world a disservice by sealing off certain important IT career paths and opportunities.*

Granted, there are many courses teaching machine-independent topics, such as AI, but there is no general course which covers modern IT – and that includes the mainframe. Such a course would parallel the general medical school which must precede any movement to medical specialisation and I believe this principle – general before specific - applies to the IT world.

It would provide the base for following the mutation of jobs which occurs in IT whichever job you are in. It is said that the half-life on a particular job in IT is 24 months so a shift in skills is almost inevitable for most people.

If businesses undertaking digital transformation are hampered by talent shortages in key and critical application areas, their future does not look very rosy and we have alluded earlier how many companies rely heavily on mainframes.

Endnote

> *Which sane person can claim the mainframe is dead, dying or that there is no future in joining the mainframe band wagon? As Mark Twain noted; 'Everybody is talking about the weather, nobody is doing anything about it'. His thesis applies to the IT skills shortage today, especially in the mainframe arena which the above statistics show is vital to commerce and industry.*
>
> *It is also crying out for people who can handle the mainframe beasts, hence IBM's efforts to take the mainframe to students and others who would otherwise be unaware of it and the career opportunities associated with it. There are many dead-end jobs in IT; the mainframe route is not one of them.*

There are many aspects to the mainframe and with them many job types and levels. The *mainframer* might get grey hairs in that environment but never bored. His/her only regret on retirement may well that they didn't sample all the job wares the mainframe offered.

References (of many on the same topic)

The Mainframe is Here to Stay: 5 Take-Aways for Mainframe DevOps
http://www.devopsdigest.com/the-mainframe-is-here-to-stay-5-take-aways-for-mainframe-devops

As Baby Boomers retire, the shortage of mainframe professionals grows more acute
http://www.networkworld.com/article/3161857/hardware/as-baby-boomers-retire-the-shortage-of-mainframe-professionals-grows-more-acute.html

Author's Books

Open Systems: The Reality
BCS Practitioner Series   ISBN 0-13-030735-1

High Availability IT Services
https://www.crcpress.com/High-Availability-IT-Services/Critchley/9781482255904

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Modern IT Concepts and Technology: An IT Study Guide for Beginners and Practitioners Kindle Edition

https://www.amazon.co.uk/dp/B0826XN9L2/ref=sr_1_1

Appendix

IBM has been offering mainframe education for some time now to try to fill the mainframe skills gap which is mainly a result of the disappearance of mainframe veterans due to retirement and other reasons. There are no credible mainframe courses offered in schools, Universities or similar education facilities and IBM has stepped in to remedy this urgent need.

In the early 1990s, IBM and other IT companies had financial problems, many of them due to raid growth. The major IBM customers were aghast at the distant prospect of IBM's demise and almost told IBM ' .. *don't you dare fail or many of us will follow you'*. Many companies today rely almost 100% on IBM mainframe products in their business and this is the impetus for quality mainframe training and underlines the importance of solid mainframe environment support.

One starting point for this training is the IBM Student Hub, accessible via the link below.

IBM Z Global Student Hub
'For students wanting to explore IT careers and the technology that powers the Fortune 500 companies and oils the wheels of the world of financial transactions.'
https://community.ibm.com/community/user/ibmz-and-linuxone/groups/community-home

This hub has three main sections:

1. *Master the Mainframe*, a competition for mainframe students. You can kick off with this learning via the next link:

Master the Mainframe Learning System Registration
https://www-01.ibm.com/events/wwe/ast/mtm/audit.nsf/enrollall

2. *Start on IBM Z*, which is a start point for learning about the current mainframe environment in a variety of ways
3. *Past Webinars*, where the learner can check out what has been discussed previously, complemented by blogs created by other learners.

On the Hub, the learner can ask questions, find webinars and learning resources, and develop their skills and it is hoped these tools and resources help learners to explore the world of enterprise computing.

If participants have any questions, they can be posted in the discussion board so there is a community feel about this mode of learning, as close as one can get to campus learning.

There are learning facilities, such as videos and blogs by fellow learners to help others understand what this unique education environment is about.

Of course, IT cannot live by the mainframe alone but by the software, services and methodologies which support it. These too can be picked up by working from this hub and from connections within it.

In addition, there are external courses on specific aspects of the mainframe, for example, COBOL and CICS, the backbone of much of the work done on the mainframe.

Dr Terry Critchley   tcritchley07@gmail.com   2020