Research Talk: Autonomic Computing and the Future of IT Service Management

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Many of the tasks that IT Service managed are house-keeping tasks: tweaking network performance, installing upgrades, changing printer profiles, connecting new equipment to the network, optimising the database. We face a constant battle to keep the systems performing and to adapt to a changing environment, to changing demands and to changing service level agreements. There seems to be no such thing as a stable system. Once one element is working another goes down, a virus causes an alert and downtime or there is a new demand for system changes.

Such problems of a changing environment are only amplified by the increasing complexity of the systems we're trying to maintain. Customers anywhere in the world now regularly access internal systems. Integration between internal systems and system running over the Internet is required. EDI links with external companies only increase the complexity.

In this environment, no amount of extra hardware or management procedures will give us sufficient control. The complexity is increasing to a point to point where it's beyond our control.

The situation is not going to get any easier unless we take a different view of the software and systems. Future systems are going to have to be able to do their own housekeeping. Software will need to be able to adjust to the environment, make alterations in response to environmental change and organise itself as and when required by a service to meet the demands of that service.

Researchers in industry and universities are realising that software systems need radical rethinking. The day-to-day functioning of computer systems must be automated. And software must be able to adapt itself to changing business needs.

At IBM, the entire research strategy has been re-oriented to tackle this problem. Called 'Autonomic Computing', IBM's view of the future of computing is based on a biological metaphor.

Consider the systems at work in our bodies. The heartbeat is constantly altering to meet demands on the body. Blood sugar is monitored and additional sugar released. Fight or flight mechanisms respond to stresses and emergencies, releasing adrenaline and altering many metabolic systems. Breathing rates, digestion and temperature are all controlled without our having to think about it. This is the autonomic system, regulating the body through chemical and electrical signals.

Why shouldn't computer networks and systems do the same? Complex systems should manage their basic functioning without IT services intervention. Developing systems that do this has become the focus of IBM's research. What will these systems do?

The entire functioning of autonomic computer systems will be self-governing. They will be able to respond to environmental changes, install themselves, alter performance and respond to threats. IBM research has identified eight key elements of an autonomic computing system.

- The system will have self-awareness. It will know what resources it has and where they are. It will have a system-wide awareness.

- The system will be able to configure and reconfigure itself. It will be able to install itself at new locations, move software and storage to where it's needed and carry out reconfiguration in response to

environmental changes both internally in the organisation and externally in the global informa tion systems environment..

- The system will be self-monitoring and will be constantly seeking self-optimisation. It will look for better network traffic routes, fine-tune its workflow and optimise its performance.

- The system will be self-healing able to recover from malfunctions. It will be able to discover real or potential problems and resolve them. It will call into action redundant or under-utilised elements and route resources to where healing is needed. It will analyse problems and learn from them, generating its own rules and routines for dealing with new events and problems.

- The system will protect itself, identifying threats and reacting to them, developing protection against new viruses using an artificial immune system.

- It will be sensitive to its environment, identifying neighbouring systems and working out how to interact with them. It will adapt to changing business demands. It will identify new devices and gather new environmental data from them. It will be aware of changes in user's actions.

- The autonomic system will manage itself in an open environment, where global computing is the norm and connections between internal organisational systems and global networks are natural and expected. It will operate in a non-proprietary environment, connecting to other computing systems and resources as needed.

- The autonomic system will anticipate IT resource requirements; drawing in extra resources or redistributing existing resources in response to anticipated business change.

These elements do not require traditional artificial intelligence but rather the feedback, control and response mechanisms analogous to those in the body which run the autonomic system. These mechanisms would enable self-awareness, adaptability and, importantly, the hiding of the complexity from the user, so that the user concentrates on achieving business requirements rather than tweaking computer systems.

Of course some of the technology for autonomic computer systems already exists in networks and software. However, a lot of new ideas and mechanisms will be needed and it is the overall goal of autonomic computing and shift in focus which is important.

In the UK, an Engineering and Science Research Council supported group is look at new ways of building and delivering software. The group from Manchester, Durham and Keele suggest that:

- Software should be developed to meet necessary and sufficient requirements so those users can acquire only the functionality they want and don't have to pay for unnecessary sophistication.

- Software should be personalised, providing users with business functions tailored to their exact work processes.

- The software should be self-adapting, changing process and interface structure to meet changing business need and user patterns of working.

- The software should be structured in small simple units which combine as and when needed to meet service requirements.

- Distribution and software configuration should be transparent and controlled without user or professional intervention - it should be autonomic.

The group proposes a service-based model of software development and provision in which software is configured on the fly to meet a service need. Software components aggregate in response to a service

requirement and then disaggregate when that service is not required. Software building is then dynamic and service-driven. The service is the master of the software, not the software the master of the service.

At the Centre for IT service management research we have been looking at ways of structuring software which can adapt to its environment, using the biological mechanisms we know operate in cells in the body. We envisage the actual definition of the software being stored is small units like genes in a specification. These small units are built up form even small units of processing. Mechanisms in the system read these off and turn them into executable components which aggregate under the control of special components we call homeotic components to form systems. Changes in the environment and new requirements can be transmitted to the specification and result in new combinations of small processing units and components created by recombination of existing components and processing units.

By such mechanisms adaptive evolutionary information systems may be able to sense changes in user requirements, both from user input and other environmental indicators, and change their structure in order to create new processes and data to meet the changing business need.

So what will be the consequence of autonomic computing systems, service-based software and adaptive evolutionary information systems for IT service management?

There may be a shift away from the management of the technology to the management of the technology interface with the user. We will no longer need to concentrate on configuring and reconfiguring, on bug-fixing and restoring the system, or on implementing upgrades and installing systems. The system will install itself, configure itself, heal itself and do its own upgrades.

Our focus will be on managing the user's service requirements, defining the service we want from the system, defining the service level agreements and issuing them to the system. We will move from IT support to business support, identifying the IT service necessary to underpin a business service, and using the autonomic computing systems to deliver those services.

Our focus will move towards the business demand. Our role will be one of service innovation and creation rather than service maintenance We will define the services and leave it to the service-based software to form the aggregations and bind together the system needed to deliver the service. Our help desk service will become business-focused rather than technically focussed. Rather ringing in and asking 'Do I need a new upgrade for my customer system?' they will ask 'Do I need a new IT service for this customer?'

As far as system administration is concerned we will leave the 95% routine activity to the autonomic system and concentrate on the 5% exceptional challenges.

Autonomic Computing may be a little way off, but if we are to cope with the exponentially increasing complexity of computer systems, its arrival is inevitable. It will bring with it new challenges, the relief of drudgery in the IT service department and new role for IT services which is much closer to the business than the technology.

Research Talk is a new series for Service Talk looking at research topics in service management, information systems and computer science which impact on the IT service management community. Articles will provide some challenging new concepts and draw out practical ideas for service management. Research talk is provided by the Centre for IT Service Management, De Montfort University.

Useful web sites: IBM's Autonomic Computing Research Programme:
http://www.research.ibm.com/autonomic/index_nf.html

EPSRC's Interdisciplinary Software Engineering Network: http://www.service-oriented.com/isen/index.html

Centre for IT Service Management Research: http://www.cse.dmu.ac.uk/cism/service_management.html