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# Problem Diagnosis in Large Scale Computing Environments: Approaches Towards Automated Healing

In 2001, IBM warned the IT community that it is marching towards a looming software complexity crisis. In their opinion only a change of mentality would avoid a blockade of the IT industry – they were proposing to build autonomous computing systems. In my master thesis the essential requirements of autonomous systems and the state of the industry (how close of accomplishing this goal are we) were identified. As practical part of the thesis, a “solutions data base system” was built. It provides a way to find solutions for known problems and to add solutions to new ones.

Root Cause Analysis

Self Healing

Self Aware

Self Management

Autonomous Computing

## Challenges of the Future of IT

As IBM suggested, in 2001, the solution to avoid deadlock of progress in IT industry would be to empower computer systems to manage and protect themselves.

The term chosen for the new breed of systems, autonomic computing systems, wasn't picked randomly. It comes as a direct reference to the autonomic nervous system of the human body. In the same way the nervous system assures the correct functioning of the human body – by adjusting the blood pressure, heart beats or temperature – an autonomic computing system will make sure that it functions properly.

The main characteristics that make a computing system, autonomous are: self management, self configuration, self optimization, self healing and self protection. So a system would have the possibility to protect itself from malicious actions or errors that might prevent it from doing its intended job. Also it will have the ability to integrate itself among the existing systems of a company and do so only by following high-level guidelines from administrators. It will assure that it functions optimally by monitoring and adjusting its performance at all time. And most important it will take care of all this while remaining invisible to the normal user.

Even though the systems management market offers various options to the user, none of them is even close to what a real autonomous systems should be.

Currently the most innovative of the Application Performance Management applications facilitate the administrators to identify the problems in a distributed environment by collecting information and pointing out the erroneous component of a system.

By measuring the time needed for a given component to execute its intended task and by comparing it with other execution times, the problematic component is found.

At this point it's the job of the administrator to find a solution for the given problem. In order to make the identification of the proper solution easier, during the master thesis project, we tried to improve the process of finding a solution by offering the means to quickly identify the faulty component and also to search for a solution.



## Steps Towards Self-Awareness

The project was developed on top of an existing APM tool. The explicit goal of my thesis project was to develop a solutions database system. The given application provides an user the means to search for solutions for occurring problems. When a solution can't be found, the problem will be added to the database for a later solving by a technical expert.

For problem mapping the system uses call-stack comparison and full-text search comparison based on human readable descriptions of the problems. The next step for the system would be to add monitoring capabilities – so an applied solution will be monitored in order to see if it was successful or not. Also the solutions search and mapping will be improved by adding artificial intelligence to the system.