

Nominee: Humanitas Research Hospital

Nomination title: Patient Care Continuum

Humanitas Research Hospital is an Italian top-tier general hospital based near Milan. Humanitas employs approximately 2,300 people, annually provides care services for about 37,000 in-patients, 2,300,000 outpatients and more than 53,000 accesses to emergency room.

Humanitas aims to improve the treatment of the patients through a translational approach of the results of the scientific research and also hosts a research center, focused in the area of immune-degenerative diseases and an international medical and nursing school, Humanitas University.

The increasing complexity of the clinical cases requires the development of new healthcare pathways to enable collaboration between different professionals; the final aim is to meet all the patient's needs in terms of health, care and social welfare. Humanitas is therefore developing a new organizational model for provisioning health care services within Clinical Service Lines, which are patient centered integrated pathways able to improve the quality and the appropriateness of the care for specific classes of diseases.

To consolidate Clinical Service Lines, Humanitas is working on multiple levels, implementing measures to:

- revamp the organizational model
- develop a patient-centric IT platform

In this context, IT is a key enabling factor in order to provide:

- coordinated patient care
- patient empowerment
- clinical, business and operational analytics
- standards and interoperability

As a hospital, Humanitas operates 24 hours a day, 365 days a year; it is therefore one of the most challenging environments to run an ICT infrastructure.

In 2013, in order to meet the business needs mentioned above, the Board of Humanitas asked the ICT department to address these challenges, both on applicative and infrastructural side, supporting at best the company's strategy. Humanitas decided to implement a best of breed electronic medical record, an enterprise-wide system, targeted to help clinical staff in patient care activities, collecting data and supporting research activities. Such a wide-ranging project led to a number of challenges, from design to implementation. The project deeply involved all the ICT team and the whole organization, so it was mandatory to work in a coordinated manner.

Humanitas started its first virtualization project in in 2005 adopting VMware.

The infrastructure reached its structural growth limit in 2013: the storage could no longer be expanded, servers had inadequate processors and memory, the network was a bottleneck for high demanding services, related to the exchange of the clinical images.

Many IT systems were end-of-life with rising maintenance costs. Therefore, the IT infrastructure needed to be revised to overcome technical obsolescence and to enable the clinical business needs. The outcome was an infrastructural project, based on virtualization of servers and storage that would guarantee high reliability for the clinical services delivered to the patients.

The design of the new IT infrastructure project implied:

- use the VMware Hypervisor, due to Humanitas expertise with this product
- implementation of a VMware stretched cluster and an IBM San Volume Controller (SVC) in order to achieve high reliability

The project had to consider the following constraints:

- migration of more than 150 applications, mainly clinical, to the new IT infrastructure within 8 months
- business continuity of the clinical services during the migration

To meet the requirements, a VMware stretched cluster was implemented, with hosts distributed across two server farms; stretched clusters balance workloads between two data centers, with non-disruptive workload mobility.

Two IBM Pureflex were acquired, one per server farm. The systems, highly integrated, simplify and optimize the implementation with the result of less space, less cabling and less time needed to start up.

The three existing clusters were consolidated in a single cluster with the same number of hosts, with increased RAM and CPU capacity. The power increased from 226 to 600 GHz, provided by Intel E5 processors, the RAM increased from 1.2 to 5 TB. Humanitas maintains the same number of VMware vSphere licenses providing better performances (+70%) without costs increase.

A prerequisite of the stretched cluster is an extended layer 2 network with a latency of less than 5 ms: to reach this goal, a pair of Cisco Nexus 5000 were acquired, one per server farm, and linked to four IBM switch en4093r inserted into the two IBM Pureflex. This new datacenter network is able to overcome the limits of the old network infrastructure.

The SVC and the two IBM XIV generation 3 storages were installed, one per server farm. The XIV storage systems have a grid storage architecture: highly reliable, performant, scalable and manageable.

The SVC is a storage virtualizer that replicates information from two underlying storage; VMware datastores are replicated in real time. In case of fault, the system automatically switches the supply of the LUN from one server farm to the other; it is also able to compress data in real time

so it is now possible to compress the datastores to nearly 50% without losing performance while saving costing storage.

The overall system, involving the network, servers and storage area, allows Humanitas to have a redundant virtual infrastructure across two server farms in its own campus; so that the eventual loss of a server farm doesn't affect the business continuity, considering that Humanitas has a highly specialized Emergency Room.

The implementation phase of the virtual infrastructure was successful except for a problem that occurred during the network load test phase: some NICs stopped working, isolating the servers . The trouble ticket scaled up to the IBM development team in the US. Emulex, the NIC manufacturer, released a new driver to address this problem, after a long period of data collection and testing.

The major benefits of this project are the resilience to failures, a substantial increase in performance, ease of deployment of new VMs and the maintenance of the entire virtual infrastructure.

The consolidation obtained with the new servers and storages led to a lower energy consumption and less space needed in the server farms.

As a result, more than 150 VMs were moved to the new infrastructure.

The infrastructure is designed to increase capacity without losing performance. The agility of the new infrastructure enabled the installation of approximately 160 new VMs in the last year (+75%).

Why nominee should win

- **Implementation of a complex virtualization project within the peculiar context constraints (time, budget, business continuity of clinical services and care delivered to the patients during the migration of the clinical applications).**
- **The virtualized infrastructure is redundant (two server farms) in order to achieve business continuity. The VMWARE stretched cluster gives the high reliability required to operate 24 hours per day, 7 days a week which is vital in an hospital environment.**
- **Performances improvement, optimization of the virtual server's management, maintenance costs reduction.**
- **The IBM SAN Volume Controller technology grants full power availability, reliability and IBM XIV Gen 3 storage scalability.**