Leadership and Management in Software Architecture (LMSA'08) - A Report on an ICSE Workshop

by

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1. INTRODUCTION

Software architecture, in education and practice, is primarily concerned with technical issues associated with the quality of software architecture and design. However, as project size increases, leadership, management skills, and the organizational context of the architect become more important, to the point where the non-technical duties of the project architect can "make or break" a project. The workshop on Leadership and Management in Software Architecture that took place at ICSE 2008 was focused on understanding these non-technical duties and the type of support an architect should expect from an organization.

Attendees at the workshop, in addition to the organizers, were Shareeful Islam, Technical University of Munich, Marcelo Cataldo, Bosch Corporate Research, M. Ali Babar, Lero , Charalampos Kyriakou, GGSB, Tuna Capin, Asalan, Inc, Leonid Volkov, SKB Kontur, Qaises Saied, AERO Pakistan, Takahide Matsutsuka, Fujitsu Laboratories of Europe, Oliver Creighton, Siemens Corporate Technology, Hans Ros, Siemens Corporate Research, Ana Ivanovic, Philips Research, Ibrahim Armac, RWTH Aachen University. The presented papers at the workshop are available at [2].

The activities of the workshop consisted of two extended discussions. One centered on the skills that an architect should have and the second centered on the responsibilities of the organization to make architecture be a key aspect of the development process. We now discuss

2. ARCHITECT'S DUTIES

Rob van Ommering in an essay on his duties as an architect [3] identifies twenty six activities he might do in a day. Twelve of these involve interpersonal activities. Items such as "communicate concepts" and "explain … strategies" are included. On the one hand, these are technical concepts but on the other the ability to explain and communicate is non technical.

Other items in his list are explicitly non-technical. "selecting people, talking to requirements manages, talking to project management" are all based on communication skills and involve to varying extents, selling, persuading, and judging.

Paul Clements and his colleague [1] have surveyed a collection of software architects to determine their duties, the skills they feel are important and the knowledge they feel is important. A large number of these duties, skills, and knowledge are non technical.

During the workshop, the attendees generated a list of skills and background that characterize the ideal lead software architecture for a project. Most large systems are developed today by different teams working in different locations, most likely on different continents. In such an environment, the skills of the architect need to include the ability to deal with different cultures, different sets of motivations, and different contractual situations. This means that the necessary skill set of the architect very explicitly has a strong overlap with the sill set of a successful manager. Although no individual is likely to have all of the skills and background that we have enumerated, such a list is useful in helping individuals who wish to become lead architects focus on improving their skill set in the areas in which they are deficient and in helping organizations select the individuals who are lead architects for large projects. We categorize the skills into four areas – technical, managerial, business, and domain. We also describe some other experience such an individual should have.

2.1 Technical skills

Having technical skills is important for the lead architect because the system being built is a technological system. Technical skills are necessary to enable:

- Negotiating with system architect from a position of knowledge
- Managing technology vision so the product has long term viability
- Understanding the constraints imposed by the domain
- Inspiring subordinates to follow the leadership of the architect.
- Managing non-functional requirements
- Gaining the respect of management

- Identifying and managing systemic risks arising from technical decisions
- Managing vendor relationships
- Designing or managing the design of the system.
- Identifying opportunities to innovate or infuse disruptive technology

2.2   Management skills

Because the lead architect acts as the technical lead for the project, he or she must necessarily have a collection of skills that are common to other leadership positions. We identified the following characteristics of a lead architect:

- Be able to quickly grasp technical arguments.
- Have self awareness of his or her limitations and areas where his or her knowledge is lacking
- Have self confidence
- Have the ability to make decisions in a timely manner and the ability to appropriately defer decision making.
- Have the ability to listen and gather information
- Have the ability to delegate
- Have the ability to manage a group. In particular have the ability
  - To motivate
  - To organize
  - To assigning roles and responsibilities
- Have the ability to manage stakeholders including customers, users, and developers
- Have the ability to abstract
- Have the ability to focus
- Have the ability to lead.
- Have the ability to manage complexity

2.3   Business skills

Because the lead architect is being constrained by business considerations and because the business goals of the project are embodied in the architecture, the architect must have the following business skills.

- Have the ability to communicate with management and the customer in their language.
- Have the ability to make business case for key decisions
- Have the ability to elicit business goals
- Have the ability to participate in product selection
- Have the ability to anticipate business opportunities
- Have some marketing skills so that he or she can create mockups for sales or marketing.
- Have the ability to identify new business models
- Have the ability to anticipate evolution and maintenance of system
- Have the ability to understand business constraints in order to meet them.
- Have the ability to know when to push back on business constraints
- Have the ability to define what characteristics will make a product competitive
- Have the ability to ability to sell disruptive technology to business decision makers

2.4 Domain skills

Because the system is being constructed for a particular domain, the lead architect must have an understanding of the domain as well. This is because

- Different domains have different requirements on the architecture.
- Coupling between non-functional requirements may be different in different domains.
- Environment of use of the system differ among domains,
- Business requirements differ among domains.
- The lead architect must be creditable when communicating with customers
- The lead architect must understand the users
- Available technology will differ among domains.

2.5 Experience

In addition to the skills we have enumerated, the lead architect should have had experience in delivering a product. Actually delivering a product means having experienced firsthand the tradeoffs that must be made among the various stakeholders desires in order to meet deadlines. The lead architect may not have been responsible for these tradeoff

decisions in his or her past but he or she should have lived through them so that they understand the reality of getting a product delivered.

3. ORGANIZATIONAL SUPPORT

Even the most skillful and talented architect cannot operate effective without some level of organizational support. The workshop discussed the responsibilities of the organization with respect to supporting the architect and architecture centric development. The organization has the responsibility to:

- Create facilities and training for project transparency mechanisms. The organization should support a culture of technical transparency so that project members understand the rationale for technical decisions.
- Hire and train the appropriate architects.
- not discipline staff for reporting architectural problems
- Provide the architect with adequate information to perform a cost benefit analysis when a requirement may be changed.
- Have management follow organization processes when dealing with technical issues, e.g. a high level manager should not bypass change control board or architect.
- ensure that software lifecycle processes are designed to be used and useable
- Fund the software development tools and staff training per architect recommendations so that productivity is not diminished and personnel can receive appropriate training.
- Understand that allocation of work prior to definition of architecture engenders coordination needs that must be supported via adequate resources.
- Define architectural processes that are understood, communicated and supported within a single organization. Cross organization process interfaces need to be defined, understood and followed.
- Communicate long term strategy and vision to the architect/ architecture team.
- Define metrics for subcontractors/subunits that are appropriate for the systems being developed.
- Consult with the architect before making product definition decisions to determine that products are technically feasible.
- Define architectural processes that are flexible so that the architect can customized on a per product/per project basis.
- Encourage decision makes to receive appropriate architectural training so that they can understand the importance of architecture centric development practices.

3. SUMMARY

Although a one day workshop cannot hope to be comprehensive or even consistent, the participants in this workshop brought a great deal of knowledge to the workshop, engaged in spirited discussions and produced lists of skills for the architect and responsibilities for the organization that are provocative and that point out considerations that organizations should address in the hiring, training, and support of software architects.

4. REFERENCES

[1] Bass, L., Clements, P., Kazman, R., and Klein, M., Models for Evaluating and Improving Architecture Competence. CMU/SEI-2008-TR-006. http://www.sei.cmu.edu/publications/documents/08.reports/08tr006.html

[2] http://www.sei.cmu.edu/architecture/LMSA08/

[3] Van Ommerling, R. Things to do in Denver when you're an architect http://www.sei.cmu.edu/architecture/ThingsToDoInDenver.htm