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A Classification of Knowledge in Enterprise System Roles

Roy Chan
Queensland University of Technology

Michael Rosemann
Queensland University of Technology

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Roy Chan and Michael Rosemann

Centre for Information Technology Innovation
Queensland University of Technology
Brisbane, Australia
rw.chan@qut.edu.au

Abstract

A wide range of studies in Enterprise Systems (ES) has been conducted in recent years. These studies often address the lack of appropriate in-house Enterprise Systems knowledge and the need to manage ES-related knowledge. In so forth, organisations realise the need to better leverage their knowledge resources. However, it often not clear what this' knowledge' is, what type(s) of knowledge are relevant and who possess this knowledge. This paper is based on previous research, which categorized six types of knowledge based on a comprehensive literature review. Based on this classification, an analysis of the dominating ES implementation tool, ValueSAP, has been conducted. Further insights into the expected knowledge and skills have been derived from this vendor-specific viewpoint. The results provide perspectives on the expected contributions of the different members in an Enterprise Systems project.

Keywords

FD05 IS implementation approaches, EH0208 IS skill requirements, Enterprise Systems, Knowledge Distribution

INTRODUCTION

Enterprise Systems (ES) are business applications that replace legacy systems with a comprehensive integrated solution (Hernandez, 1997). The integration of all functional areas along the value chain requires a great amount of experience from a wide range of project members such as representatives from business departments, technical specialists and project managers within the organisation to external business and implementation consultants. As such, implementing comprehensive IT applications such as Enterprise Systems is a knowledge-intensive task. The vast expertise and knowledge embedded in the range of people involved in the ES is diverse and varied. On one hand organisations want to reduce the engagement of costly consultants, but on the other hand hardly any organisation has the internal knowledge and skills to implement an ERP system successfully without external help (Haines and Goodhue, 2000).

Most existing ES literature has focused on methodologies and critical success factors required for the implementation of Enterprise Systems (Bancroft, 1996; Clemons, 1999; Kirchmer, 1999; Mahrer, 1999; Scott, 1999; Slooten and Yap, 1999; Sumner, 1999). However, literature does not clearly define what this 'knowledge' is, what type(s) of knowledge and skills are required within an Enterprise Systems project. Knowledge resources can be better managed by having the transparency about what knowledge or skills is required at which point in time and where the knowledge resides. By identifying what knowledge (skills)[1] is required for the different ES roles, managers and implementation consultants can more effectively select, implement, use and upgrade the system. Furthermore, an appreciation of the importance for each knowledge type allows one to understand how the different flux of knowledge influences the overall lifecycle of the ES.

This paper is structured in the following manner. The next section positions this research in the context of the knowledge required for Enterprise Systems. Six relevant types of knowledge are introduced. This is followed by a description of ValueSAP, a market leading methodology and tool for the implementation of the Enterprise System SAP R/3.

[1] The terms 'knowledge' and skills are used interchangeably within this paper. Where the term 'knowledge' is mentioned, the authors refer to the skills required for ES.

Documentation of ES roles in ValueSAP provided the empirical evidence for this research and a content analysis of the documentation has been conducted in order to understand the distribution of knowledge to roles in typical roles in these projects. Selected results of this analysis are presented. This paper ends with a brief summary and an outlook on future work in this area.

MANAGING KNOWLEDGE FOR ENTERPRISE SYSTEMS

Since advents in information technology and data processing, the information age has been gradually turned into a 'knowledge society' (Drucker, 1989). The emphasis is on managing an organisation's knowledge resources as the key to growth. While the related literature acknowledges the importance of knowledge and the dynamics and strategies of managing knowledge, a widely accepted taxonomy of relevant knowledge types could not been established.

Numerous authors have used a multitude of different, yet often analogous adjectives to represent the different types of knowledge. This paper adopts the definition from the perspective of knowledge in the procedural and declarative sense as reviewed by Zack (1999:45):

- *Declarative knowledge,* or knowledge about, refers to the ability to recognise and classify concepts, things and states of the world.
- *Procedural knowledge,* or knowledge how, refers to the understanding of an appropriate sequence of events or the ability to perform a particular set of actions. This may include organisational ceremonies and rituals as well as everyday operating procedures and routines. Procedural knowledge can be represented as ordered sequences of events associated with particular roles and relations.

This distinction of knowledge from Zack (1999) has also been reflected by many other authors (Anderson, 1980; Machlup, 1980; Pears, 1971; Ryle, 1966; deJong, 1996; Lemat, 1988; Reif, 1987 all cited in Freeman, 2001:255-257). Freeman (2001) notes that "Skills, especially, are usually concerned with procedural knowledge – the ability to do something with an information system, complete some task, or fix a problem". By studying skills, this research focuses on the abilities and expertise required by ES roles in order to facilitate the accomplishment of tasks and activities required in an ES project.

Zmud (1983:258) suggested six types of knowledge and skills required by all employees:

a) *Organisational Overview* – objectives, goals, purposes, opportunities, constraints, internal and external functioning;

b) *Target Organisational Unit* – application of organisational skills to internal or external unit;

c) *Organisational Skills* – interpersonal behavior, group dynamics, project management

d) *General IS Knowledge* – hardware and software concepts, IS policies and plans, and IS applications

e) *Technical Skills* – methods and techniques required to perform implementation tasks

f) *IS Product* – Purpose, design, required procedures, impacts on individuals.

Martinsons and Cheung (2001) found in their study of perceptions of skills in IT management that business knowledge ranked the highest with interpersonal skills. This is followed by project management knowledge and technical knowledge.

From the literature reviewed on cases studies in Enterprise Systems (Chan and Rosemann, 2001), six separate types of knowledge have been derived:

a) *Business knowledge* covers the business issues in the management of Enterprise Systems. This includes *functional knowledge* in areas such as general ledger accounting, purchasing, sales, human resource management, or strategic

planning, *organisational knowledge* like business process management, communication policies, or document management and knowledge about the industry-specific business processes.

b) *Technical knowledge* represents knowledge that is necessary in conjunction with the selection and use of database management software, network management, add-on programming, client-server-architectures, performance measurement, etc.

c) *Product-related knowledge* reflects the need for knowledge, which is specific for a unique ES solution. Most ES solutions are comprehensive packages with a high degree of complexity. This area of knowledge includes among others the understanding of the architecture of the product, knowledge about its functionality and existing constraints, the implementation methodology, or knowledge about the ES-specific programming language (like SAP's ABAP).

d) *Company-specific knowledge* covers knowledge, which is specific for one organisation with specific characteristics and an individual organisational population, organisational culture, social norms and practices, rules and policies.

e) *Project knowledge* includes the management of resources, time and cost to accomplish the objectives of a project.

f) *Communication, Co-ordination, and Collaboration knowledge* includes the capability to exchange and integrate the different types of knowledge between various knowledge owners.

Zmud's (1983) organisational overview, organisational skills, target organisational unit, general IS knowledge, technical skills and IS product corresponds to Chan and Rosemann's (2001) business knowledge, project knowledge, company specific knowledge, technical knowledge (general IS and technical inclusively) and product knowledge respectively. A significant part of communication knowledge exists in Zmud's (1983) organisational skills (interpersonal/ group skills). More obviously, the common thread is seen in Martinsons and Cheung's (2001) treatment of business knowledge, project management knowledge, technical knowledge (programming languages), product knowledge (software packages), and communication knowledge (interpersonal skills). It is apparent that the categories of knowledge and required skills do not differ significantly in the last 20 years (Zmud, 1983; Martinsons and Cheung, 2001; Chan and Rosemann, 2001). The research is conducted with the classification by Chan and Rosemann (2001).

VALUESAP – METHODOLOGY, OBJECTIVES AND COMPONENTS

A methodology is defined by Maddison (1983) as "a method of developing an information system, with identified phases and sub-phases, recommended techniques to use in each phase and sub-phase, and recommendations about planning, management, control and evaluation of a development project and its various phases and sub-phases." A plethora of IS methodologies has been proposed (Maddison, 1983; Iivari *et al*., 2001). However, while many contributions revolve around IS *development* methodologies, there is substantially less literature on IS *implementation* methodologies (Iivari *et al*., 2001).

This lack of theoretical foundation is a significant drawback for off-the-shelf-solutions such as Enterprise Systems with its focus on implementation issues. At this stage, the related research has not proposed a standardised implementation methodology that corresponds with elaborated Systems Analysis and Design approaches. This might explain the dominance of vendor- and product-specific methodologies. One of the most popular methodologies (and tools) for implementing an Enterprise System is SAP's ValueSAP. ValueSAP is used by consulting firms such PriceWaterhouseCoopers, Accenture, KPMG and Deloitte and Touche. It provides a comprehensive methodology for the entire Enterprise Systems lifecycle with the three phases Discovery and Evaluation, Implementation and Continuous Business Improvement. A set of tools, reference solutions and accelerators (re-useable Word, Excel and PowerPoint files) supports this methodology.

The core of ValueSAP is known as ASAP. SAP introduced the Accelerated SAP (ASAP) implementation methodology in 1996 with the goal of streamlining and standardising SAP

implementation projects. ASAP utilised the experience and expertise gleaned from many implementations all over the world and across different industries. The Accelerated SAP implementation methodology is a structured implementation approach that differentiates project preparation, business blueprint, realisation, final preparation and the actual go-live and support.

ASAP consists of a roadmap that provides a reference work plan for the implementation (Dolmetsch *et al*., 1998). The Implementation Assistant guides the project team through this roadmap. Each of the more than 500 activities in this roadmap includes a detailed description of the purpose, the pre-requisites, the detailed activities and the outcomes. Each activity also has a reference to the proposed roles that are supposed to be involved in this activity.

ValueSAP has been chosen as the source of evidence for this research as it consolidates comprehensive knowledge gained over many years in a high number of ES projects.

Research related to ValueSAP

Dolmetsch *et al*. (1998) conducted four case studies in small to medium-sized companies. They came to the result that the ASAP implementation methodology supported the critical factors for a successful SAP R/3 implementation by providing a transparent implementation process. Aberdeen (1998) found that ASAP provided assistance in facilitating the completeness and early delivery required in project training, which allowed a greater degree in knowledge transfer within the project.

ASAP is used as the SAP reference implementation model in which the relevance of critical success factors can be evaluated along the five phases in ASAP (Esteves and Pastor, 2001). “According to a survey of Input, organisations have been more satisfied with SAP tools and methodologies than with those of implementation partners” (Input, 1999 in Esteves and Pastor, 2001). In their study, they found that relevant critical success factors can be represented along the ASAP phases. The authors proposed that with the derived schema, it is possible to identify which ASAP processes are important for each factor. Moreover, it is possible to gain an orientation of the relevance of each CSF in each stage of the SAP implementation project, and to better control and monitor the success of SAP implementations.

RESEARCH METHODOLOGY – CONTENT ANALYSIS

The proposed mode for the analysis of documents in VSAP is content analysis. Content analysis is a research technique for making replicable and valid references from data to their context (Kirpendorff, 1980). As each content analysis depends on the context of the study, it is concerned with developing a methodology on its own (Kirpendorff, 1980). Content analysis is chosen as the mode for this research as it is concerned with distilling detailed skills for a set of pre-defined knowledge types (Chan and Rosemann, 2001). ValueSAP contains a description of 70 consolidated roles explained in more than 90 pages documentation.

Each description of a role is structured in the following format: name of role (title of the role), description (general descriptive statements about the job scope and responsibilities of the role), time commitment (a table which recommends the amount of time to be committed to the project depending on the project complexity), skills (skills that the role must have to effectively carry out the tasks), other highly desired skills (useful skills, but they are not necessary for the fulfilment of the related tasks), key tasks (primary responsibilities of the role) and don’ts (events/ activities to be avoided by the individual). The analysis conducted in this research only looked at the skills section of the role specification.

With the documentation provided in the implementation methodology ValueSAP, a set of rules for distilling the skills from the documentation had to been set up. The objectives of the analysis of ValueSAP were twofold:

- First, all 70 roles had to been assigned to the six identified types of knowledge. This provided insights into the relevant knowledge owners in ValueSAP.

- Second, further grouping of these 70 roles provided insights into the actual distribution of knowledge within these groups.

Two coders were used to analyse independently the documentation in ValueSAP. The primary coder was the researcher. The secondary coder was selected based on his solid understanding of ES in general and SAP in particular. This arrangement aimed to increase the reliability of the analysis while cross-validating results from both coders.

Figure 1 shows the underlying structure of this research in the form of an ER-based meta-model. In the centre of the diagram, the individual attributes of a role, description, skills, time commitment, key tasks and highly desired skills become obvious. The assignment of the skills as a part of the role description to the six knowledge types (consolidated here in one entity type 'knowledge') was the first codification that had to been conducted. The relationship type 'group' highlights the second codification, which was required. After this, it was possible to link different groups of knowledge owners to different types of knowledge.

As indicated above, each role in ValueSAP is also assigned to one or more activities in the ES lifecycle. Each activity belongs exactly to one lifecycle phase. This connection allows future research to generate a profile over time that indicates what type of knowledge is required in what stage of the Enterprise Systems lifecycle. However, at this stage the research does not consider this lifecycle yet.

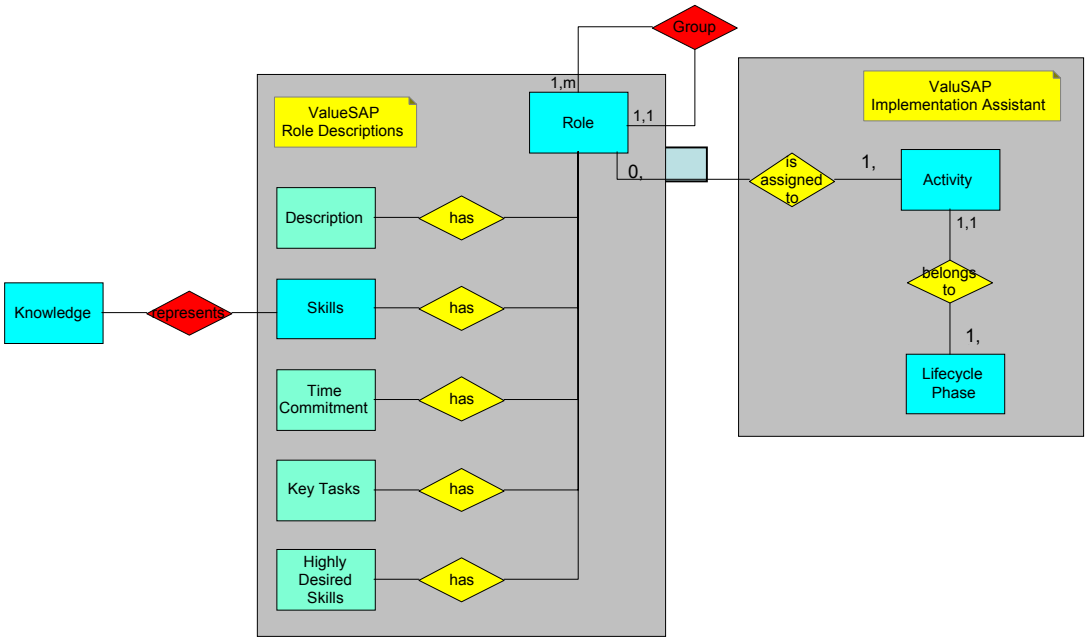

Figure 1: The Meta model for roles in ValueSAP including the two codifications

PRELIMINARY RESULTS

The following sections provide consolidated insights into the results of the content analysis. Two main outcomes are discussed in the following sections, the knowledge distribution for different groups of roles and a classification of skills.

Knowledge Distribution

The following roles have been consolidated to the group of consultants, SAP Consulting Manager, SAP Technical Consulting Manager, SAP Reviewer, Application Consultant, Consultants and Facilitators, Internationalisation Consultant, Process and Organisation Consultant. Based on the assigned skills the following knowledge profile has been derived from the content analysis (see Figure 2).

Consultants are engaged for their knowledge and experience with a specific product. This product-specific knowledge can typically not be found on the client's side. Consultants are perceived by the software vendor, based on ValueSAP, as having a high amount of product-specific and general business knowledge. In addition, it is evident that these consultants are

not supposed to have knowledge about the specific organisation. They are expected to have a high learning curve based on their business knowledge about the client's industry from other implementations. This lack of company-specific knowledge may be one explanation why organisations do not fully reap the benefits from the ES. Another observation is the reasonable small amount of requested project-specific knowledge. This could be seen as another reason for project failures as recently been documented in the case of National Australia Bank (Howarth, 2002).

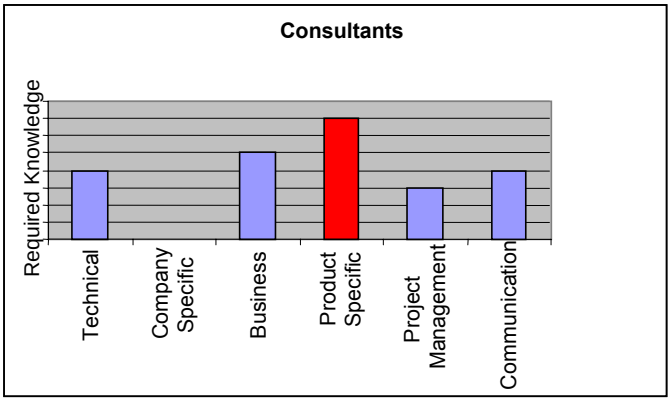

Figure 2: Knowledge distribution in the group consultants

Users (6 roles: Business Process Team Lead, Business Process Team Member, Business Process Owner, Power User, Documentation Developer, Help Desk Provider and Manager) have a perceived higher need for company-specific knowledge (Figure 3). On the other side it is expected that they have little product-specific knowledge. Obviously, consultants are hired to fill the gap in product-specific knowledge that end-users do not possess. This maybe the reason why users do not fully understand the functionality of the ES, but only often perform data entry and system test related tasks. Users are seen to have a high need for business knowledge for their daily operations and in so forth, require communication, co-ordination and co-operation knowledge to foster the completion of tasks.

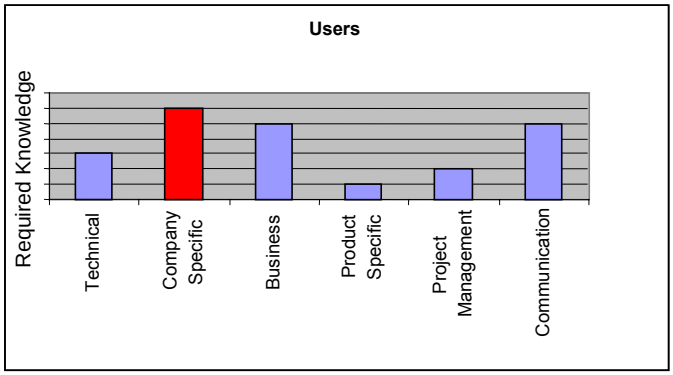

Figure 3: Knowledge distribution in the group users

The technical team (13 roles: Technical Team Lead, Development Manager, Program Developer, Layout Developer, System Administrator, Database Administrator, Network Administrator, Operating System Administrator, Authorisation Administrator, Technical Consultant, IT Expert, Security Administrator, Legacy Systems Expert) obviously requires, and has indeed, the highest count of technical knowledge. Technical personnel are perceived to have advanced levels of technical expertise but lack in the perspective of ValueSAP business knowledge. As rooted in literature, one of the reasons for the failure to align information systems to business and vice versa could be that technical personnel are unable to link technical processes with the business world due to insufficient business knowledge. The technical team evolves their understanding of the product knowledge through the implementation of the Enterprise System and is expected to have an overview of the project during its configuration phases.

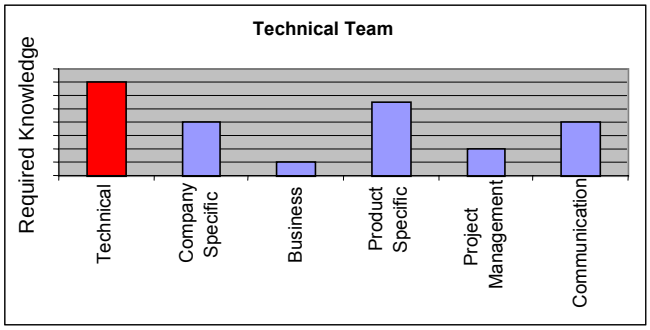

Figure 4: Knowledge distribution in the group technical team

Senior Management (4 roles: Steering Committee Member, Project Sponsor, TeamSAP Project Manager, Customer Project Manager) accounts for the highest count of business and project management knowledge (Figure 5). Senior Management is expected to be able to have a "big picture view of the project vision and goals, and the ability to communicate this to the project management and business process team" (ValueSAP documentation). They are not expected to participate in configuration tasks and implementing the technical or product specific components of the Enterprise System.

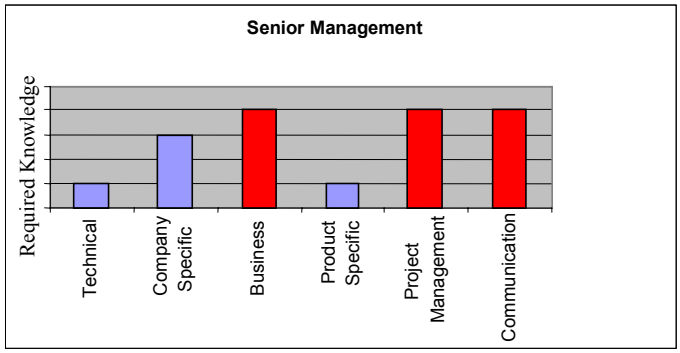

Figure 5: Knowledge distribution in the group senior management

From the results above, it can be seen how knowledge is distributed throughout the involved groups of roles. Consultants are expected to lend their expertise to support the lack of product-specific knowledge that the technical team, users, senior management supposedly do not have. The users have the most amount of company-specific knowledge that is accounted from their use of the Enterprise System in relation to the business processes. It is also shown how the flux of knowledge interacts with each individual group. The lack of knowledge and skills in one group is complemented by knowledge and skills that another group possesses.

Classification of Skills

Based on the assignment of individual skills to six generic types of knowledge, it was possible in the second step to further analyse the list of assigned detailed skills. Figure 6 shows as an example the different skills items the knowledge type technical knowledge based on the documentation available in ValueSAP. The tentative sub-sets of each skill is formed through the set of rules from the content analysis. This list is compiled from the existing terminologies used in the documentation. For example, 'Technical competency in data modeling' includes three sub-skills that consists the referential units 'data' and 'modelling'. No further terminologies have been added or adapted to the list.

This classification of technical knowledge allows an understanding of what detailed constructs are supposed to belong to certain skills in an Enterprise Systems project. The list shows that technical knowledge includes IT understanding and IT application skills. Such a list can be interpreted as the result of a reverse engineering approach. A hierarchical structure of technical knowledge or other types of knowledge cannot be found in ValueSAP or ES literature. The hierarchical classification allows comprehensively appreciating the

range of required skills required for ES roles, which facilitates an appropriate identification and staffing of resources.

SUMMARY AND OUTLOOK

This research in progress paper deals with Knowledge Management for Enterprise Systems. Based on an existing classification of relevant knowledge types, it has described how an analysis of a market-leading implementation tool can provide further insights into the distribution of knowledge and skills in different groups of project members. The results for the groups of consultants and end-users have been discussed. Furthermore, a detailed list of specific skills for each knowledge type could be derived as a result of this analysis.

This research contributes to a better understanding of required knowledge in Enterprise Systems projects. Empirical evidence is provided in this case by a implementation tool that consolidates person-years of consulting experiences. Moreover, the research provides practitioners with interesting insights into how the dominating Enterprise Systems vendor perceives the distribution of knowledge between consultants and end-users.

Future work will be investigated in two directions. The analysis of ValueSAP will be completed taking the assignment of roles (and their assigned skills) to the activities in the Enterprise System lifecycle into account. Based on such an analysis it will be possible to profile the demand for different types of knowledge over the time of an Enterprise Systems project. Finally, further empirical evidence will be consolidated by interviewing experienced consultants and clients who are familiar with ValueSAP. The outcomes of this research will then be used as a benchmark for all results that have been derived based on the tool analysis.

1) Technical Knowledge

Basic IT understanding

Technical competency; with strong computer skills /Technical aspects of the solution
A strong technical implementation background with either package or custom application systems
Technical expertise with experience in multi-systems implementation and distributed environments
An understanding of the end user's data
An understanding of the source data (both SAP and non-SAP data)
Expert hardware/software knowledge
Program management experience with large, complex programs
Knowledge on the management aspects of (one or more) legacy systems
Expert knowledge of site LAN/WAN setup
Appropriate experience with authorization administration and management
Appropriate experience with authorization administration and management in networks
A strong background in development tools (Workbench, VBA, DHTML, ActiveX and etc.) or systems administration
Strong systems or tools knowledge
Strong technical troubleshooting and analytical skills
Knowledge of progress tracking and other reporting mechanisms
Knowledge of system equipment/facility requirements
Experience with appropriate operating system management
Expertise in appropriate content development tools and methodology
Expertise in appropriate content development tools, and development and delivery process

Application skills

Advanced application software skills including but not limited to presentation, spreadsheet, word processing, and program management applications.
Advanced application software skills, including presentation, spreadsheet, and word processing applications
Advanced application software skills, including presentation, spreadsheet, word processing, and project management applications
Application software skills, including presentation, spreadsheet, and work processing applications
Knowledge of application software tools, including presentation, spreadsheet, and word processing applications
Adequate knowledge of database platform and network
Experience in administrating company-wide client server applications and off-line distributed database applications
Experience in 4G/L languages, and an in-depth understanding of development tools
Experience with the appropriate data access tool(s)
Experience with appropriate relational database administration
Experience with the administration of a distributed database (center & field databases)
Technical competency in data modeling
An understanding of multidimensional modeling
An understanding of the differences between operational systems data modeling and data warehouse data modeling
Experience with Data Modeling application software (i.e., ERWIN, Oracle Designer, S-Designer, etc.)

Figure 6: Technical Knowledge – Skills classification

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