

# Understanding Information Needs of Facility Managers in Preventive and Corrective Building Maintenance Practices, A Qualitative Approach

**Masoud Gheisari, Ph.D.**  
Mississippi State University  
Starkville, Mississippi

**Javier Irizarry, Ph.D., PE**  
Georgia Institute of Technology  
Atlanta, Georgia

In order to keep the human professional in charge and to enable him/her to solve meaningful problems in a manner that is as natural as possible, new approaches that are more user-oriented should be used to augment human capabilities. In this research, a qualitative user-centered information needs assessment approach was utilized that provides information requirement of facility managers. This information has the potential to ultimately lead to the development of human-centered Information Technological (IT) tools. This Goal Directed Cognitive Task Analysis (GDTA) qualitative user-centered technique has not been broadly considered as a potential method of improving the cognitive decision-making process within the Architecture, Engineering, Construction, and Owner (AECO) domain. This study applies the GDTA technique in healthcare facility management, in order to obtain the key goals and information requirements of performing their tasks. As the result of the GDTA methodology, a hierarchy of goals, sub-goals, decisions and information required for achieving the goals has been provided. These information requirements lay the foundation for future role-based decision support systems that can assist AECO personnel in their decision making process within dynamic and information-rich environments throughout the life cycle of a facility from the construction to the operations phase.

**Keywords:** task analysis, qualitative, user-centred, GDTA, facility management, human factors.

## Introduction

The International Facility Management Association (IFMA) has a broad definition for facility management (FM) which is (IFMA 2009) “the practice or coordinating the physical workplace with the people and work of the organization; integrates the principles of business administration, architecture, and the behavioral and engineering sciences.” As it is clear in this definition, facility managers work in a complex domain with a large amount of information to keep up with. Therefore, they should be capable of understanding the information requirement of their practices in their working environment. This means that facility managers should have a clear understanding of what their goals, decisions, and information requirements are. For understanding this information requirement and goals, semi-structured interviews were conducted with professionals in the field of facility management. These professionals are referred to as Subject Matter Experts (SMEs) due to their professional background, experience and expertise in the area of facility management. By following the methodology of the Goal Directed Cognitive Task Analysis (GDTA), a hierarchy of goals, decisions and related information requirements was developed. The findings presented through this hierarchical structure have the potential to be the basis for the development framework of a human-computer interface that can be used on desktop computers, Personal Digital Assistants (PDAs), and Smart Phones to help facility managers to access appropriate information anytime anywhere and improve decision-making performance in their respective domains.

## Research Methodology

In this research, a form of cognitive task analysis, Goal Directed Task Analysis (GDTA), will be used (Bolstad, Riley et al. 2002). The GDTA will be employed broadly for analysing information requirements of individuals (Endsley 1993, Endsley and Rodgers 1994). Reasons for selection of the GDTA include: (1) it is not tied to the technology being used to carry out the task (i.e., it is independent of how tasks are done within a given system but it depends on what information is needed); (2) it does not just focus on people's data needs, but on how the data can be used within decision-making and the goal attainment process; and (3) it focuses on obtaining an accurate depiction of the information requirements and key goals for each individual (Strater 2001). The GDTA has three main components: goals, decisions, and information requirements (Endsley, Bolte et al. 2003). It focuses on: (1) the basic goals of the operators; (2) the major decisions for accomplishing these goals; and (3) the information requirements for each decision. The knowledge obtained through the GDTA can help designers to design systems that enhances information access of facility managers together with their decision-making and performance. The steps involved in a GDTA semi structured interview are as follows (Endsley, Bolte et al. 2003):

- Identification of key decision-makers: the key decision-makers who are playing the significant role should be chosen for applying the GDTA methodology.
- Identification of major goals and associated sub-goals for each decision-maker: each decision-maker should be asked about his/her main goal.
- Identification of the primary decision needed for each sub-goal: each decision-maker should be enquired about the sub-goals, which are necessary to accomplish the main goal.
- Identification of the information requirements for making those decisions and performing each sub-goal: The sub-goals would serve to set the direction for clarifying the primary decision needed for each sub-goal and the information needs to accomplish those sub-goals.

Various domains, such as fighter aircrafts, electronic systems and automation technology, driving and ground transportation, energy production and distribution, space operations, nuclear power plant management, and medicine, are applying the SA methodology (Endsley 2000). AECO industry has also previously used this method in construction safety (Gheisari et al. 2010a), general facility management (Gheisari et al. 2010b, Irizarry and Gheisari 2013), and disaster management (Son et al. 2008) domains. Identification of key decision makers would be a very important step that clarifies the target population of this study. Considering facility managers in general as the target population of this study would lead to significant challenges in performing the GDTA methodology. Based on the author's previous experience in applying GDTA to the FM domain (Gheisari and Irizarry 2011), not narrowing down the target population of the facility management practices to a specific groups would lead to discrepancy of goals or requirements between various facility management SMEs. The problem happens due to very large scope of facility management domain and the very different backgrounds of the SMEs. These issues would influence their priorities, goals, and requirements as facility managers. Professional and experienced managers should be chosen considering a very detailed scope for the operational level of the Healthcare Facility Management. Narrowing down from general Facility Management domain to the Healthcare FM as complex infrastructures and focusing only on experts in the HVAC system (operational level) would lead to a group of technicians who are working as a facility manager or under the supervision of a facility manager and would provide an appropriate set of goals and requirement as the result of the GDTA.

GDTA involves semi-structured interviews in which the interviewer would ask each Subject Matter Expert (SME) about his/her main goal as a healthcare facility manager. The interviewer would continue to enquire about the sub-goals, which are necessary to accomplish the main goal. These sub-goals would serve to set the direction of the remainder of the interview and clarifying the information needs to accomplish the sub-goals of a healthcare facility manager. Creating a comprehensive GDTA for a particular job would take anywhere from 3 to 10 interviews, depending on the complexity of the position (Endsley, Bolte et al. 2003). One-on-one interviews were conducted with those managers following the GDTA methodology. The interviews lasted approximately one hour and were voice recorded for the purpose of reviewing responses. A study protocol was prepared and reviewed by the Georgia Tech Institutional Review Board (IRB) for compliance with Human Research Subjects regulations. Based on the protocol, subjects provided their consent before the interviews. The information obtained from the GDTA was organized into a figure depicting the hierarchy of the three main components of the GDTA (i.e., goals/subgoals, decisions relevant to each subgoal, and the associated information requirements for each decision).

## **Semi-structured Expert Interviews**

Eight professional facility managers who were expert in the HVAC-related practices were chosen as Subject Matter Experts (SMEs). They were all professional practitioners in the metropolitan Atlanta, GA. Having easy access to these professionals was the main reason of choosing them all from metropolitan Atlanta. Four of the interviewees had more than ten years of experience in facility management practices and the other four had between five to ten years of experience. Five of the interviewees had associates degree and the other three had high school diploma as their highest educational/training attainment. The GDTA Semi-structured Interviews conducted with those eight SMEs provided the necessary information for understanding their goal and information requirements. Their responses were combined and a unique set of goals for the facility managers (HVAC technicians) was achieved. This section explains this set of goals and information requirements.

The main goal of an HVAC-related facility manager was identified as providing a safe and comfortable facility for patients, staff, and visitors through quick preventive maintenance and repair. The interviewees mentioned that they basically should deal with “comfort cooling, and heating of people in facility”, “make sure everything is working correctly”, “maintain all equipment and prevent major problems”. For achieving this main goal, technicians mentioned that they should accomplish two major subgoals:

1. Monitor current status of all equipment: Preventive Maintenance (PM)
2. Fix/repair any problem that would occur for all equipment: Corrective Maintenance (CM)

A typical day for facility technicians starts usually with going through what has happened through the previous night and checking whether those problems have been fixed or not by the night crew. Communication between facility managers and technicians usually happens through their cellphones or mobile two-way radios. Technicians usually do walkthroughs to check the general status of their designated zones in the facility and making sure nothing is wrong. If they do not have any CMs to do, they would start on PM checklists. But if any emergency and corrective kind of maintenance happens the priority would be with those CMs. This makes everyday different and unique for technicians since any unpredicted or unprecedented issues might happen in the facility which requires prompt attention of the facility group. There are usually three crews of technicians who are working consecutively in three daily periods of 7am-3pm (day), 3pm-11pm (evening), and 11pm-7am (night). Some facilities might have less number of crews or smaller crews for evening and night periods depending on the facilities working hours and complexity. Facility technicians are usually in charge of the very common and more frequent kind of PM/CM tasks such as checking the filters, belts, and replace the faulty ones, checking the temperature in different areas of the facility, or simple installation (e.g. oven or valves). Third party contractors are usually in charge of the more technical kind of PM/CM tasks.

### **Preventive Maintenance (PM)**

Preventive Maintenance (PM) means monitoring all equipment and facilities and making sure they are in satisfactory operating condition by providing regular inspections to proactively detect and correct the incipient problems. Generally all those PMs are based on checklists that technicians have to go through periodically to make sure everything is working perfectly. These checklists are step-by-step sets of tasks. Usually an automation technician printout the PM checklists from the Computerized Maintenance Management System (CMMS) and provide them to the technicians to do their periodic PMs. Considering the type of the equipment that should be maintained the PMs might happen sometime between a daily or yearly basis. The technicians would be assigned specific number of PMs and when they perform those maintenance tasks they have to provide PMs to the facility management front desk to key in the checked marks in the CMMS.

As previously mentioned one of the goals of the HVAC technicians is to monitor the current status of all equipment within facility to make sure they are working faultlessly. For achieving this goal, the technicians mentioned that they should exactly know what equipment they have to monitor as well as details of the required maintenance tasks. For fulfilling this purpose the technician declared that they should be able to firstly locate the target equipment in the facility through the closet route in the facility and then they should also be provided with some required information such as average time of performing the maintenance task, the steps that should be followed to fully maintain the equipment, different related components in the equipment, and the due time/date for maintaining the target equipment.

Another issue that should be considered for achieving the goal of monitoring the current status of equipment within the facility is to make sure that the technicians have required knowledge to maintain the target equipment. For fulfilling this purpose, the technicians not only should have the required training for fixing the equipment but also they should have access to the history of all the maintenance tasks that have been performed on the equipment. The technician should also have the contact information of the experts and lead technicians in the maintenance group or outside contractors, if there is a serious problem with the equipment that the assigned technician can not fix it.

### **Corrective Maintenance (CM)**

Corrective Maintenance (CM) happens after a failure has occurred and means identifying a problem that has happened in a facility or its equipment and correcting that failure to bring the whole system back to in-service operations. One of the sources of the CMs is the customers and occupants of the facility. Based on the technicians' comments in the GDTA interviews, those sources are patients, staff, and visitors in a healthcare facility who contact the customer service center to inform the facility group about a problem. The majority of the CM calls that the maintenance group gets are usually for too hot or too cold situations. Typically there will be someone doing these hot/cold CMs, who could call the duty mechanic to handle the problem. This duty mechanic would be one technician specifically designated to resolve general CMs (e.g. hot/cold calls, leaking, bad smell in the area, refrigerator breakdown). This position usually rotates between technicians. If this person cannot fix the CMs then other technicians, or in sever conditions, outside contractors would help to resolve the issue. The technician would go through some predefined steps that have been trained to do to troubleshoot and figure out what caused the system to fail and how to fix it.

As previously mentioned another goal of the HVAC technicians is to fix/repair any problem that would occur for any equipment within the facility. For achieving this goal, the technicians mentioned that they should exactly know who made the request and what the details of the problem were. For fulfilling this purpose the technician declared that they should be able to firstly determine the source/person who requested the CM (e.g. name and contact information). The source can provide good information about the details of the problem. Technicians also mentioned that they require other information such as severity of the problem, the location of the equipment or components inside it, the closest route in the facility to the target equipment, the history of the entire maintenance task that had been conducted on the equipment, and where/who to get the problematic part from.

Similar to PMs, another issue that should be considered for achieving the goal of fixing/repairing any problem is to make sure that the technicians is capable of fixing the problem. To fulfill this requirement having information such as whether the designated technician has required/similar training for fixing that specific issue, and has access to the contact information of the associated contractor and equipment supplier would be beneficial.

Figure 1 illustrates the goals and information requirement of HVAC-related facility managers which are in two areas of Preventive Maintenance (PM) and Corrective Maintenance (CM).

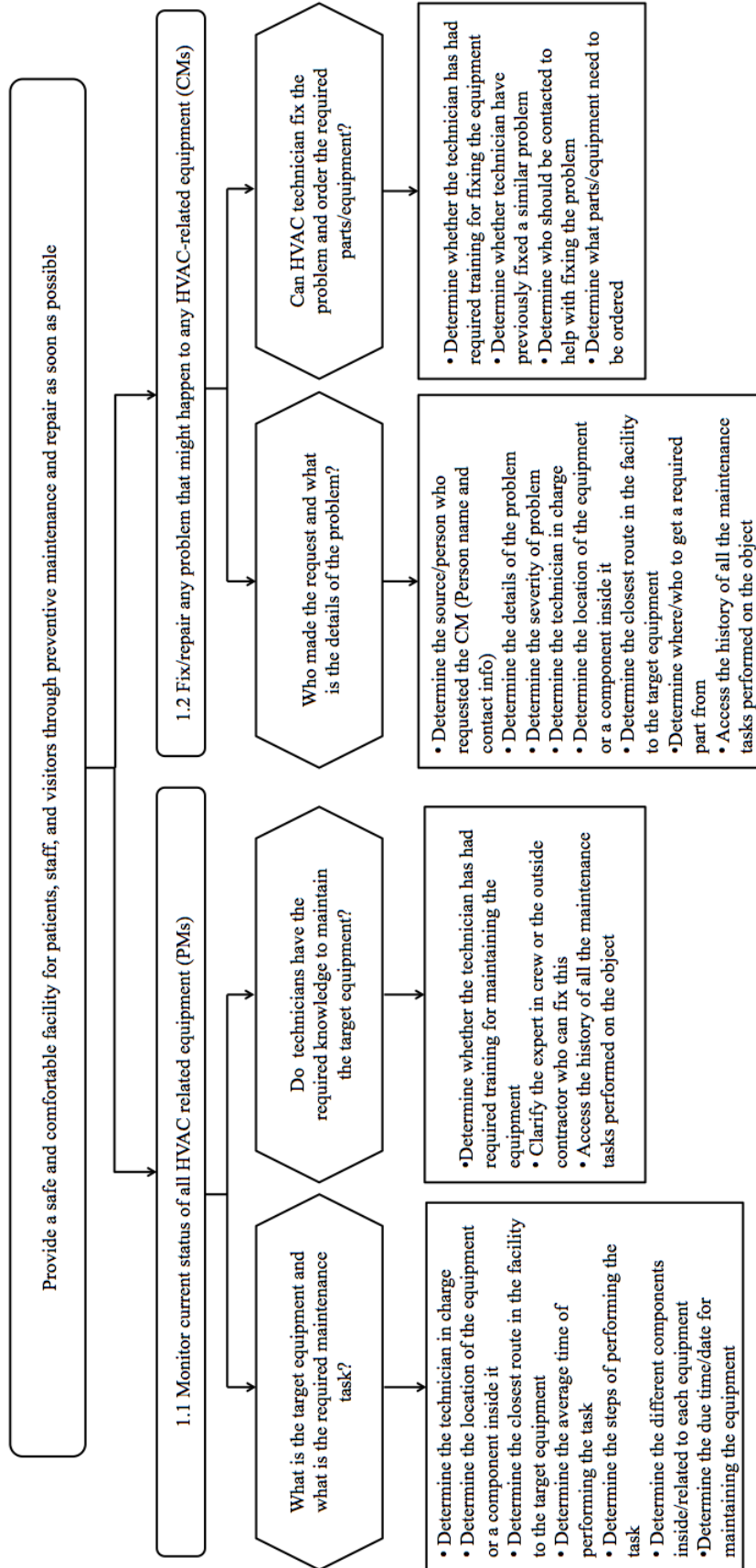


Figure 14: Goal hierarchy of HVAC-related facility managers

## Conclusion

Main decision makers in the complex healthcare facility management environment should be capable of understanding their exact information requirement at their working environment and make sure their required information have been correctly implemented within those systems that they are interacting with on a daily basis to access their required information. GDTA approach was used, as qualitative user-centered information needs assessment tool, to investigate healthcare facility managers' goals, decision, and information requirement. After conducting interviews with professionals in the field of healthcare facility management following the GDTA methodology, a hierarchy of goals, decisions and related information requirements was developed which had two main parts of preventive maintenance and corrective maintenance. The identified hierarchy has the potential to enhance ambient awareness of facility managers in their complex, dynamic working environments. Facility managers would make more accurate decisions by having previous knowledge of what could be their key goals and information requirements. This technique has great potential of improving facility management practices by identifying critical information and requirements for decision-making. Through the application of the GDTA methodology, initial steps in systematic identification and mapping of the information needs of facility managers have begun. In addition, the hierarchy can be used as basis for the development of a human-computer interfaces, which can be installed on computers and mobile devices to be used as a decision making tools in facility management practices. This hierarchy can be improved in a way to embed more detailed goals and information and even be applied in other areas of built environment design, construction, and management. Applying this methodology to other areas of the AEC domain and understanding their various goals and information requirements can lead to developing a comprehensive framework for the AEC domain.

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