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# **CHAPTER 03**

## ***Methodology***

### 3 Methodology

For the development of any trade, experience of involved stakeholders is very valuable. Even for this study, experience of stakeholders is equally important. In case of VRV air-conditioner installations, experience of designers, consultants, contractors, owners, maintenance engineers and managers are rather important as they have involved with the entire processes from the preliminary study to the operation and maintenance of the system. Their inputs, opinions, views and recommendations are very important to make the outcome of any research study realistic. Therefore, it was decided to explore experience, opinions, comments and recommendations of the personnel involved with the above installation on the maintainability, energy efficiency and suitability of VRV air conditioners wherever possible to supplement and strengthen the study.

#### 3.1 Appropriate method selected for the collection of information

In general, the most appropriate method of analyzing the experience and opinions of stakeholders is an opinion survey. The sample size of opinion survey is generally determined based on the population and expected accuracy. For general information survey, the accuracy will be higher when the sample size is more. But, in this type of technical information and experience survey, conventional market research methods do not work well [21]. Sample size is not a vital parameter in the case of survey on experience on many new industrial technologies. Cornelius Herstatt and Eric von Hippel report on a “lead user” method for developing concepts for new technologies / products revealed that the richest understanding of emerging new technologies is held by just a few users. It is possible to identify these “lead users” and then obtain the required information from them based on their experience [21]. According to the report published by Louis M. Rea and Richard A. Parker, the concept of considering the information delivered by a smaller number of representative people to be an accurate representation of a significantly larger number of involved persons has become a familiar and practical method of collecting information on a technology with a limited use [22]. Therefore, it was decided to perform a case study on a representative VRV installation to study the objectives instead of conducting an opinion survey of a large number of stakeholders.

### 3.2 Installation selected for the study

As described above a representative installation was selected for the comprehensive study to determine the, followings.

- Understand whether the prevailing demand for VRV air-conditioners is really because of its ability to cater the desires of purchases and users.
- Estimate the saving potential of VRV air-conditioners compared with the other available potentially applicable air-conditioning systems for the purpose and financial analysis.
- Study the maintainability of VRV air-conditioning installations based on the information collected from the Owner / Maintenance Manager of an identified representative building where a VRV air conditioning system has been installed.

To achieve the above objectives, following factors were thoroughly analyzed with respect to the installation selected for the study.

- Factors considered by the designers, project team and owners in selecting the VRV air-conditioning system for the building.
- Maintainability of the system and problems encountered by the owners of the building with regard to the maintenance of the air-conditioning system.
- Energy efficiency of the VRV air-conditioning system and its saving potential and whether the expected benefits have been gained by the building owners.
- Whether the suppliers/contractors has maintained the system to the satisfaction of building owners
- Whether the VRV technology is suitable for the building

The representative installation selected for the comprehensive study is the Sovereign Residencies. The sovereign corporate hotel belongs to Center for Banking Studies, situated at No 100C, Sri Jayawardanapura Mawatha, Rajagiriya. The hotel building consists of 64 numbers of rooms that almost equally built in 3 numbers of apartments. Main restaurant and a kitchen are located in ground floor. In addition to those three apartments the basement is used for different purpose such as tool rooms, stores, rest rooms, infrastructure facility to staff etc.

The main functions of this hotel are to provide accommodations to local and foreign guests, provide facilities for different functions and trainings etc. Food is served to the

rooms on request basis and the main restaurant is used especially for arranged functions. This installation was selected for the study as the VRV air-conditioning system installed in this building is nearly five years old and access to the information is not restricted.

### 3.3 Methodology followed for the study

After selecting the Sovereign Residencies, as the representative installation for the study, following methodology was adapted to achieve the research objectives.

- The building and the air conditioning system were inspected.
- Design drawings and design correspondence were referred.
- Project correspondences (including the correspondence related to the procurement process) which are in the official project files were referred.
- Maintenance correspondences in the maintenance files were referred.
- Discussions were held with the officers who got involved with the project in the preliminary stage, procurement stage, installation stage and maintenance stage.
- Information was obtained from the above discussions and documents. The useful and relevant information from the gathered information were analyzed to achieve the research objectives.
- Computer simulation was performed using EQUEST simulation tool to compare the energy consumption pattern of different air-conditioning options that had been considered by the project team during the preliminary stage.
- Actual energy consumption records were used to calibrate the outcome of the simulation.
- Life cycle costing for the considered options were performed to analyze the financial viability of them.
- Sensitivity analysis was done for 10 % variation of initial investment and electricity tariff.
- Conclusion and recommendations were developed based on the observations of above studies and analysis.