

System Analysis of Materiel Integrated Logistic Support Data Environment

Jun Yang⁺, Yong-li Yu, Ying Xu
Department of Equipment Command and Management
Ordnance Engineering College
Shijiazhuang, China

Abstract. For the problems of materiel Integrated Logistic Support (ILS) task, such as lacking the standardization, no uniform data source, and so on, this paper puts forward the concept of materiel ILS data environment (ILSDE). On the basis of making clear the concept, requirement analysis is carried out from ILS task, function, user, and information. System structure of ILSDE is constituted four layers, namely, application layer, object layer, data layer, and function layer. Finally, framework of research on ILSDE is built, including dimension of task, dimension of model, and dimension of level, so that basic problems of research on ILSDE can be determined. This will lay the foundation for research on ILSDE deeply and effectively.

Keywords: materiel; integrated logistic support; data environment; system analysis

1. Introduction

Materiel Integrated Logistic Support (ILS) task runs through various phases, such as demonstration, development, production, operational, and so on. It consists of different actions according to corresponding business flows. Implementing of actions involves different organizations, personnel, information, and other resources. To achieve established objective of ILS task and improve decision-making capability of ILS, actions, personnel or organization, information and correlative resources must be controlled and managed effectively, so right information can be sent to right place by right way at right time. However, current materiel ILS task can not achieve above requirements yet. Main problems are the following: (1) In the light of implementing of materiel ILS task, Standardization is scarce for business flow, organization, and function of it; (2) In the light of supporting interaction and sharing of information, there is no uniform and standard data source; (3) In the light of supervising of total life process, it is difficult for implementing of materiel ILS task to manage and control effectively.

For above problems, this paper puts forward the concept of materiel ILS data environment (ILSDE). Drawn by Equipment ILS task, system structure of materiel ILSDE is constituted on the basis of requirement analysis. Finally, framework of research on materiel ILSDE is built, and basic problems of it can be determined.

2. Basic Concepts

2.1. Materiel Integrated Logistic Support

Materiel ILS means a series of administration and technology actions to consider synthetically materiel support, and determine supportability requirements, and carry out supportability design, and plan and develop support resources, and provide required resources in time for meeting the requirement of operational readiness and reducing life cycle cost during the life cycle of materiel. According to above definition, integrated support is oriented to total life cycle of materiel, namely, it runs through various phases, such as

⁺ Corresponding author. *E-mail address:* Jn_yang@sina.com.

demonstration, concept, engineering development, production and deployment, operational and support, and so on. Object of integrated support should be total system of materiel and multilayer. Besides single type materiel, systematic and organic materiel is also included, such as materiel operational unit, materiel system. Therefore, materiel ILS can be described comprehensively from life cycle, support object, and ILS task (figure 1).

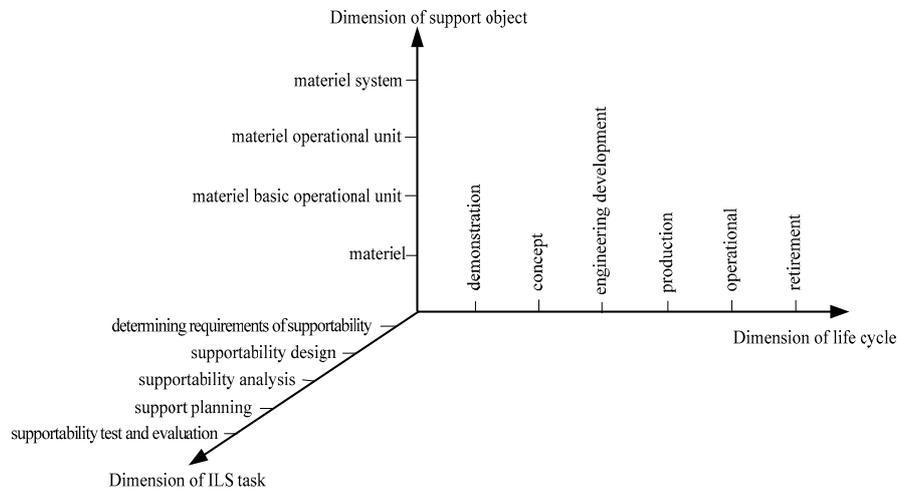


Figure 1. Concept model of Integrated Logistic support

Dimension of life cycle. It mainly reflects time domain of materiel ILS, namely, various phases of total life cycle. It includes demonstration, concept, engineering development, production, operational, and retirement.

Dimension of support object. It mainly describes objects of ILS implementing. From simple object to complicated object, from single object to systematic and organic objects, they are materiel, materiel basic operational unit, materiel operational unit, and materiel system.

Dimension of ILS task. It mainly reflects a series of ILS tasks carried out to meet the requirements of operational readiness and mission durative during total life cycle of materiel..

2.2. Integrated Logistic Support Data Environment

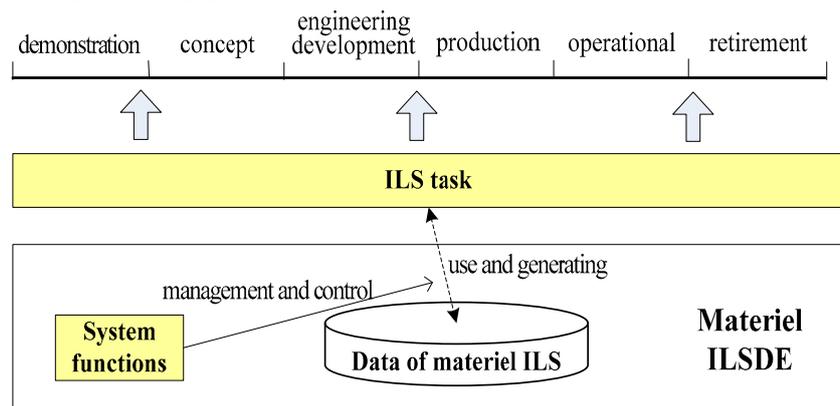


Figure 2. Total life cycle oriented equipment ILSDE

Data environment is a integrated system that makes data as its center, and provides single access for products and business data by tools and the interface, and manages and controls effectively generating and gaining of data by system functions (such as project management, business flow management) to meet data requirements of different users in various phases of life cycle and achieve the service of total life cycle. Materiel ILS and data environment can form an entirety that makes data as the interrelated basis and is oriented to total life cycle of materiel. Shown as figure 2, we can think that materiel ILSDE is an integrated system that makes ILS data as center and is oriented to total life cycle, and manages and controls generating

and gaining of data by system functions, and integrates existing software systems by tools and interfaces, and provides single access for data to meet data requirements of different users in various phases.

3. Requirement analysis of ILSDE

3.1. Analysis of ILS Task

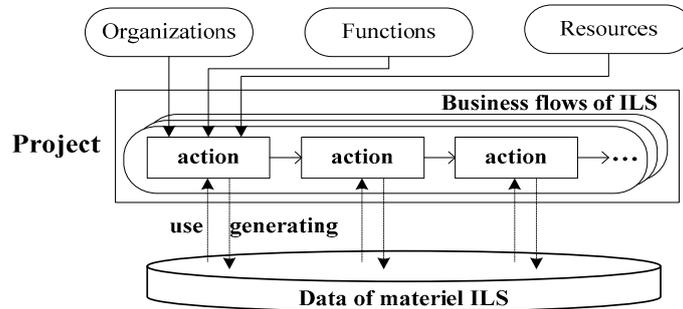


Figure 3. Elements of equipment ILS task and their relations

Purpose of analysis of ILS task is to make clear a mode of existence in data environment, and its elements and relation between elements and data. Project means a series of actions to accomplish a certain plan or task. There is a logic relation among these actions and they constitute the flow of support business. Moreover, carrying out of actions involves corresponding functions, resources, and organizations of support business. The function indicates how the action is carried out. The resource is material basis of carried out of the action, such as information, software and hardware tools, and facilities. The organization is an especial resource and made up of personnel and institutions to carry out the action. The function, resource, and organization are complement and detailing for business action. Thus, the project becomes a effective mode of describing and organizing for ILS task, and is also a basic mode of existence of ILS task in ILSDE.

Figure 3 shows that there is the close relation between the business flow and data. Carrying out of each action from the business flow need to make use of and generate data. The business flow decides flow direction of data, so use and operating of data must be specified. On the other hand, authority of data accessing from personnel and institutions should be controlled so that users can access data according to granted authority. In addition, because the function is carried out by integrating applications or software tools, applications and tools need to be deployed and called to accomplish the task assisting the personnel or institutions. Thus it can be seen that there is an important influence on use and operating of data from the business flows, actions, users, applications, and software tools.

3.2. Analysis Of Function Requirement Of ILSDE

From the view of management and application, materiel ILSDE mainly includes system functions and ILS business functions (figure 4).

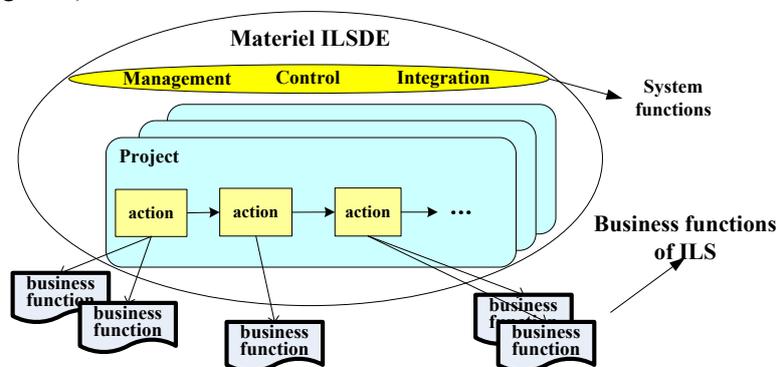


Figure 4. Elements of ILSDE function and their relations

(1) System Functions

For ensuring standard and safety of data operating, materiel ILSDE must provide some basic assistant functions to meet different needs, such as project management, management and control of business flow, control of user accessing. These functions include management, control, and integration.

Management is a basic function of materiel ILSDE. ILSDE task is specified by managing its elements, such as business flows, actions, users, and roles, so that the support is provided for use and operating data from users. The function of management mainly includes project management, business flow management, action management, user management, role management, software tool management, and so on.

The function of control is to ensure safe, reasonable, ordered use and operating data. It mainly includes user accessing control and business flow control. Considering from safety, integrity, and consistency of data, user accessing should be controlled. Whether system administrator or user, their identities and authorities must be validated and checked. Use and operating of data being carried out by accessing the action, the role of user must match distributed role of the action so corresponding check is needed before accessing the action. The software tool that carries out and accomplishes support business functions is the most direct participant of generating, using, and storing data, so that accessing authority of it need to be controlled, and input and output of it need to be checked. Thus, accessing control of user mainly includes identity validating of user, operation checking of action, and checking of software tool. The business flow decides flow direction of data and ensures generating, using, and storing of data in order. The business flow is made up of a series of actions, so right logical relation need to be defined firstly. Secondly, state of the action need to be checked according to corresponding business rules or constraints to ensure accurately running of the business flow.

In addition, ILSDE has the integrating function. For existing software system and tool to need accessing and sharing data in ILSDE, the integrating function is provided by distributing authorities and defining data interfaces.

(2) Business Functions of ILS

Business functions of ILS are from business tasks, flows, and actions. During total life cycle of materiel, corresponding business functions are included whether supportability task or support task. For example, in development phase of materiel, the task of determining supportability requirements includes the function of calculating quantitative requirements of reliability, maintainability, testability, and so on. The task of supportability design includes the function of allocation of reliability, maintainability, testability, and so on. The task of preventive maintenance includes the functions of logical decision, determining maintenance periods, and so on.

3.3. Analysis Of User Requirement Of ILSDE

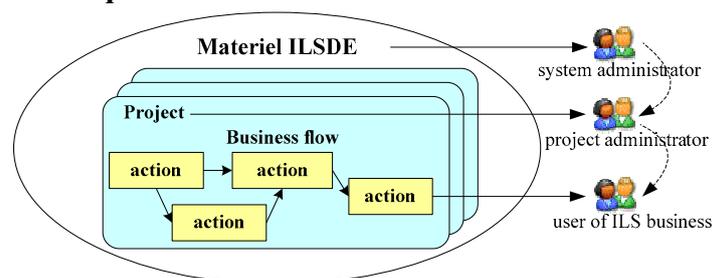


Figure 5. Users of ILSDE and their relations

Analysis of user requirement is mainly to determine which persons or institutions manage and use ILSDE. Because ILSDE includes system functions and ILS business functions, and the task of ILS exists in ILSDE by the form of project, users of ILSDE can be divided into three types (figure 5), namely, system administrator, project administrator, and user of ILS business. System administrator is in charge of overall management of ILSDE, including establishing and managing projects, business flows, actions, users, roles, and so on. Project administrator is in charge of running and monitoring of projects. User of ILS business means personnel or the institution in charge of carrying out specific actions or functions of support business. According to the relation among three types of users, System administrator is in charge of establishing project administrator. Project administrator is in charge of establishing user of ILS business.

3.4. Analysis Of Information Requirement Of ILSDE

In the light of requirements of function and user, purpose of analysis of information requirement is to determine the information framework to provide basis for data modeling and establishing single data resource of ILS. Information of materiel ILSDE mainly includes system information and ILS information (figure 6).

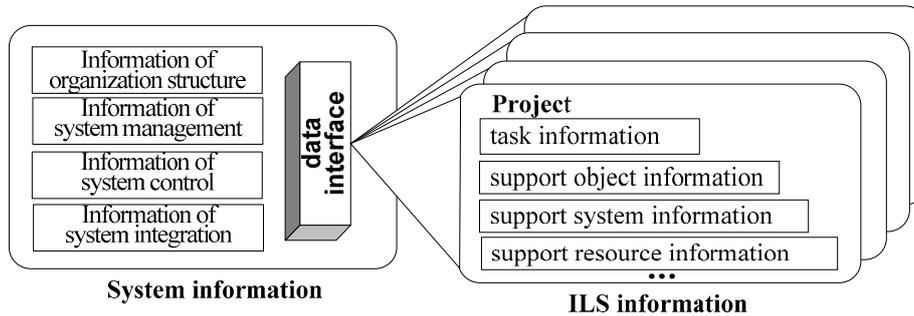


Figure 6. Elements of ILSDE information and their relations

(1) System Information

Based on user requirement, and supporting system management, control, and integration of ILSDE, system information mainly includes information of organization structure, and information of system management, control, and integration.

Information of organization structure describes organization levels, relations, and basic attributes of users from various levels, specially, composition of support business institutions and personnel, and corresponding roles and authorities. Information of organization structure includes not only information of system and project administrator, but also information of support business institutions and personnel. Detailing and abstract of information of organization structure are carried out by organization modeling and data modeling of ILSDE system.

Information of system management describes constitution of management functions of ILSDE, specially, objects involved with system management, and their relations. For example, the project, business flow, action, and so on, which attributes these objects should have. How about the relation between the project and the business flow, how about the relation between the business flow and the action, and so on. Detailing and abstract of information of system management are carried out by function modeling and data modeling of ILSDE system.

Information of system control describes constitution of control functions of ILSDE, objects involved with system control, and corresponding control relations, such as users, software tools, actions, logical relation among actions, and so on. For how to achieve the control for user accessing and the control for business flow, the mechanism, model, and method of the control need to be researched deeply. On the basis of it, information of system control is obtained by function modeling and data modeling of ILSDE system.

Information of system integration describes the objects involved with ILSDE system integration, and their attributes, namely, information of outer software systems and tools. On the basis of determining integration methods, information of system integration is obtained by function modeling and data modeling of ILSDE system.

(2) ILS Information

ILS information contains various aspects of materiel and its support during total life cycle, such as demonstration, analysis, design, management, operational and support, and so on. ILS information mainly includes the information of demonstration, development, production, operational phase. ILS information involved with ILSDE should be total system and total life cycle. It reflects not only supportability but also specific support tasks, and includes not only the information of development phase but also the information of operational phase. In addition, for different requirements and targets, ILS task may require different ILS information.

4. System Structure of ILSDE

The ultimately outcome of research on ILSDE is to structure a performable system. According to requirement analysis, a reference model of ILSDE design is given, namely, system structure of ILSDE (figure 7). It mainly includes application layer, object layer, data layer, and function layer.

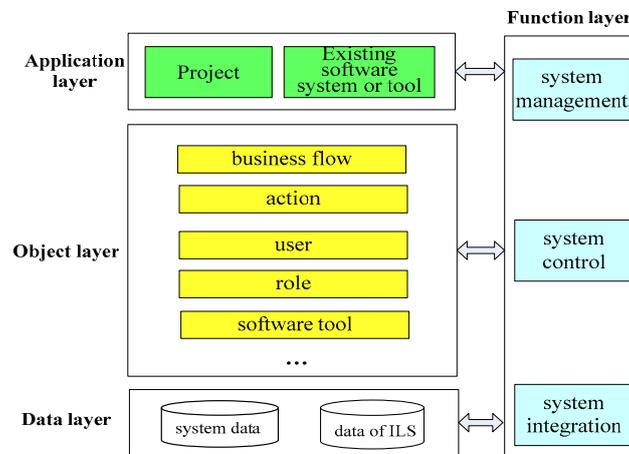


Figure 7. System structure of equipment ILSDE

Application layer is the concept representation of ILS task in ILSDE, and it mainly includes the project and integrated software systems or tools. The project specifies generating and operating of data from business layer of ILS, and is achieved by business modeling of ILS. Integrated software systems or tools put forward to requirements for generating and operating of data from the aspect of specific applications. Correlative information such as business flows, actions, users, and so on, is output by concept analysis and modeling for ILS task, and it will provide the basis for structuring object layer and data layer of ILSDE.

Object layer is the logic representation of ILS task in ILSDE. To achieve reuse and sharing, the business flow, action, user, and software tool, and so on, are made as the object, and reasonable use of data is supported by corresponding mechanism of management and control. As a core of ILSDE, object layer mainly describes the object's attributes and their relations. It can not only support implementing of the project in application layer, but also provide references for building storable and operable physical model. Object layer can be expanded along with research in depth, namely, introducing other objects required management and control.

Data layer is the layer of physical representation and store, and it mainly includes system data and ILS data, and is farther abstract for application layer and object layer. Data layer is represented with corresponding (physical) data model and can be stored, identified, and operated by the computer. It is the support and basis of effective running of ILSDE.

Function layer is a set of system functions of materiel ILSDE, and it mainly includes management, control, and integration of system, respectively managing and controlling application layer, object layer, and data layer. There are static managements, such as creation and maintenance of objects (projects, business flows, and so on), and search, backup, and recovery of data. On the other hand, there are dynamic controls, such as control of business flows, users, and software tools, and so on. Function layer reflects composition of system functions of ILSDE and their relations with function models (including control models), and ensures accurate, reasonable, and specified use and operating of data by management and control for objects.

5. Framework and Basic Problems of Research

On the basis of requirement analysis and determining system structure of ILSDE, the research framework of ILSDE is built so as to make clear the basic problems of research on ILSDE.

5.1. Framwork

Based on above analysis, framework of research on ILSDE is built from contents of task, model system, and system structure (figure 8).

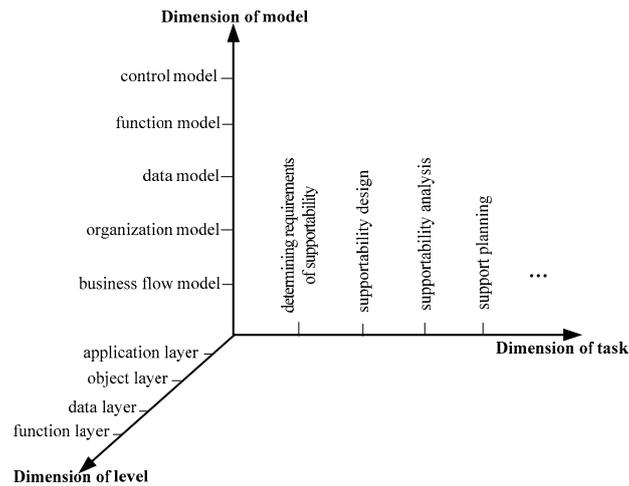


Figure 8. Framework of research on ILSDE

Dimension of task mainly describes ILS tasks during total life cycle of a certain support object, such as determining requirements of supportability, supportability analysis, supportability design, support planning, supportability test and evaluation, and so on.

Dimension of model mainly researches on ILSDE from the view of processes integration, function integration, organization integration, and data integration. To meet requirements of function, user, and information, correlative models must be built, such as business flow model, organization model, data model, function model, control model. Business flow model reflects specific implementing of ILS task by defining actions and their logical relations, and determines how the business flow is carried out and which ones will participate in and which data or information will be required, and so on. Organization model reflects organization structure of ILSDE and ILS business, including constitution, level, and relation of administrators and users of ILSDE. Data model represents system information and ILS information of ILSDE from three levels, namely, conceptual level, logical level, and physical level. Function model describes static characteristics of materiel ILSDE, and mainly reflects it's constitution of functions and their logical relations. Control model reflects dynamic characteristics of materiel ILSDE, and is built on the basis of researching and making clear control mechanisms and methods.

Dimension of level reflects system structure of ILSDE, and researches on ILSDE from the view of system design. There the relation between dimension of model and dimension of level is determined, namely, determines the model or the model group reflecting characteristics of various levels by relating with dimension of model. The project in application layer is reflected by business models of ILS, namely, business flow model, function model, organization model, and (conceptual) data model of ILS. Object layer is made up of business flow, action, user, role, software tool, and so on, and it reflects logical relation among these objects by (logical) data model. Data layer is made up of system data of ILSDE and business data of ILS, and it is achieved by (physical) data model and generates data base of ILSDE. Function layer includes system administration, control, and integration function, and is reflected by unction model and control model of system.

In figure 8, dimension of task, dimension of model, and dimension of level of framework of research on ILSDE are interrelated. Task of ILS need be described and abstracted from different models, and carries out at different levels of ILSDE system structure. In turn, only when above various models are carried out to corresponding level of ILSDE system structure can ILSDE run effectively and support task of ILS.

5.2. Basic Problems

In the light of the relation among task of ILS, model system, and system structure, the basic problems of ILSDE mainly focus on dimension of model and dimension of level. The model is the reflection of function, organization, and data of ILSDE, and that the structure relates to design and implementing of ILSDE.

Therefore, according to the relation between dimension of model and dimension of level, the basic problems of research on ILSDE are following:

Research on modeling of ILSDE. In the light of the framework, application layer is mainly to build the business model of materiel ILS, namely, build model of business flow, function model, organization model, and information model surrounding the project. Object layer is mainly to build corresponding logical data model surrounding various objects. Data layer is mainly to build the physical data model involved with the system and ILS. Function layer is mainly to build corresponding function model surrounding management, control, and integration of ILSDE. So you can see that research on modeling is the most basic problem of ILSDE.

Research on control of ILSDE. Research on control is to make clear how to achieve system control in ILSDE, and it is deepening and expanding of modeling of system function. It includes determining of control objects, research on mechanisms and methods of control, and building of control model. These provide supports for design, implementing, and running of ILSDE.

Research on integration of business tools of ILS. Whether inner software tools executing business functions of ILS or outer software systems to be independent, they use and operate data by the data interface. Research on integration is mainly to plan data interface and determine the methods of integration.

Design and implementing of ILSDE system. Design and implementing of system is an ultimately goal of research on ILSDE. On the basis of requirement analysis, system structure, and research on modeling and control of ILSDE, it designs and implements system framework, functions, and databases.

6. Conclusions

For the problems of materiel Integrated Logistic Support task, this paper puts forward the concept of materiel ILS data environment. Materiel ILSDE is an integrated system that makes ILS data as center and is oriented to total life cycle. On the basis of making clear the concept, requirement analysis is carried out from ILS task, function, user, and information. System structure of ILSDE is constituted four layers, namely, application layer, object layer, data layer, and function layer. According to above analysis, framework of research on ILSDE is built, including dimension of task, dimension of model, and dimension of level, so that basic problems of research on ILSDE can be determined. This will lay the foundation for research on ILSDE deeply and implementing ultimately.

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