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MODELLING OF ELECTRONIC KANBAN SYSTEM BY USING OF ENTITY RELATIONSHIP DIAGRAMS

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Abstract: The Entity Relationship Diagrams are often used at the design stage of information systems to identify all elements of the future system and their relationships and dependencies. This stage is the most important phase of information systems designing as the future structure and functionality depends on it. The publication deals with the analysis of the applicability of the Entity Relationship Diagrams for the design of the enterprise information system, electronic Kanban system.

1 Introduction

The utilization and active use of Kanban system has been increased in the last decades. Traditional Kanban is gradually replaced by implementation of electronic Kanban system due to technical development. Electronic Kanban belongs to the area of enterprise information systems. There are a lot of methodologies available for the modelling of enterprise information systems. One of the tools for visual representation of data is The Entity Relationship Diagram (ERD). ERD focuses on conventions which express how the data is related. The ERD uses symbols representing the main entities of the system and their interdependencies. This tool mostly belongs into the field of software engineering when working with complex databases.

2 ERD and its basic elements in relation to designing enterprise information system

The Entity Relationship Diagram consists of basic elements and elements which are based on these basic elements. Basic elements are represented by entities, attributes and relationships between entities (Fig. 1) [1,8].

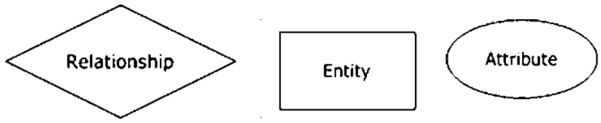

Figure 1 Graphic representation of basic elements of The Entity Relationship Diagram

Entities represent defined elements of the system such as person, object, or event which the stored information is concerned with. Entities can be combined into classes. Classes are a structured description of system components sharing common attributes. Weak entity represents a special kind of entity (Fig. 2). Existence of weak entity is dependent on existence of basic entity [2,6]. This entity cannot be identified by its own attributes.

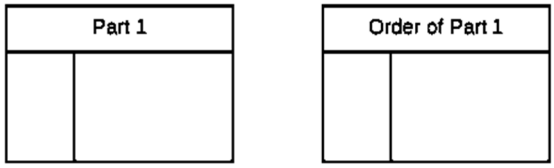

Figure 2 Entity – Part 1 and its weak entity – Order of Part 1

Attributes are specific features of entities and they characterize entities. There is no specified maximum number of attributes pertaining to one entity. It is possible to identify specific attributes for individual entities. These attributes are referred as compound attributes, e.g. compound attributes for attribute transport box could be height, width and depth of transport box. Another kind of attributes represents derived attributes. Derived attributes depend on existence of other attributes and occurrence of these attributes is rare in the Entity Relationship Diagram. Attributes can have also a certain specification where Primary Key (PK) attributes and Foreign Key (FK) attributes are distinguished (Fig. 3). Primary Key Attributes are a special kind of attributes that define a unique database entry. This specification is unique value which applies to a specific attribute. Foreign Key attributes are the opposite of Primary Key attributes, where attributes do not represent unique values. Multiple entities can share the same attributes [1,4].

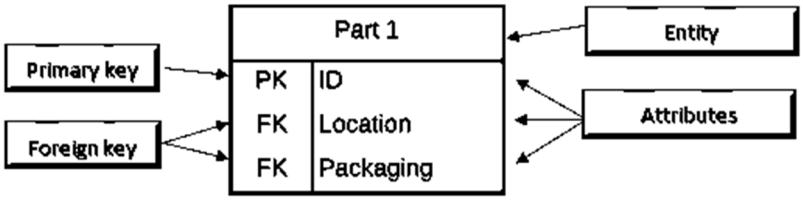

Figure 3 Attribute of entity -part

Another important basic feature of Entity Relationship Diagrams are relationships. Relationships in ERD are represented by the term cardinality of relations.

2.1 Cardinality of relationships in context of Entity Relationship Diagrams

Cardinality within the ERD expresses the relationship between two entities in a graphical - numerical form. With the aid of cardinality of relations, the occurrence of an entity which is in association with the occurrence of another entity is identified [1,6,9]. There are several notations in terms of graphical visualization of cardinal relationships, Table 1.

There are three basic cardinal relationships and these are one-to-one cardinality, one-to-many cardinality, and many-to-many cardinality. One-to-one cardinality is used to divide an entity for purpose of its simplification. Figure 4 a) expresses an example where a unique Kanban card is created for a unique part. No other Kanban card belongs to this particular part. One-to-many cardinality identifies the relationship between two entities A and B. The instances of entity A can be associated with multiple instances of entity B while the instances of entity B are associated with only one instance of entity A. At Figure 4 b) is a Kanban card for one workstation but the workstation uses multiple Kanban cards as it uses several parts. Many-to-many cardinality expresses the relationship between entities A and B where entity A is associated with multiple instances of entity B and vice versa. According to Figure 4 c) the part can be used by several workstations and at the same time one workstation is using several different parts.

Table 1 Notations of Cardinality of Relationships

Symbol	Meaning
	One
	Many
	One or more
	One and only one
	Zero ore one
	Zero or many

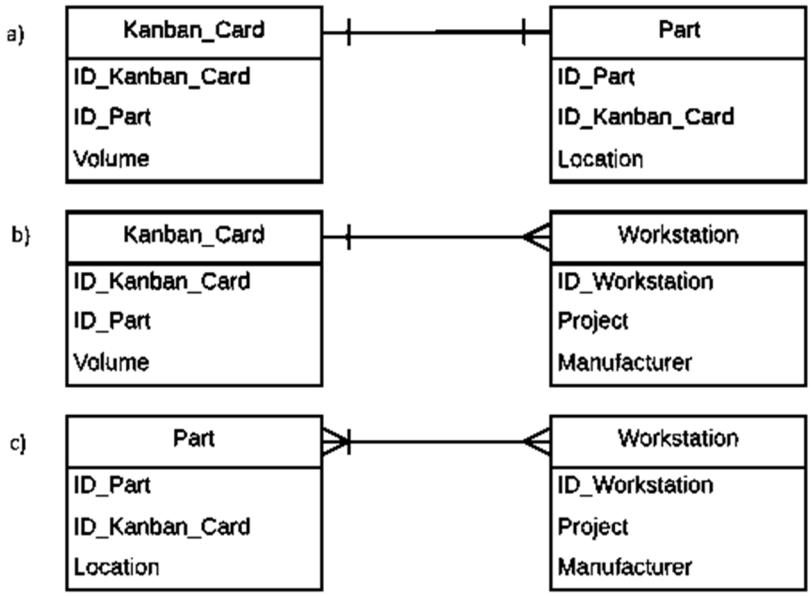

Figure 4 Basic types of cardinal relationships a) one to one b) one to many c) many to many

2.2 *Basic models for ERD visualization*

Three types of models are used to display the Entity Relationship Diagram. Each of them contains the core elements of the ERD. The difference lies in the meaning for which they are created and the target groups for which they are intended [5,7].

Table 2 Comparison of Conceptual, Logical and Physical Model

Features of ERD	Conceptual model	Logical model	Physical model
Entity	YES	YES	YES
Relationship	YES	YES	YES
Attributes		YES	YES
Type of Attributes		OPTIONAL	YES
Primary Key			YES
Foreign Key			YES

Based on the comparison of the individual features of the Entity Relationship Diagram mentioned in Table 2, for the needs of designing of the enterprise information system electronic Kanban it is possible to state the following:

- The conceptual model provides only a basic overview of the principle of system operation by identifying basic entities and their relationships,
- The logic model also deals with the identification of attributes of entities but does not allow them to be categorized more precisely,
- The physical model allows to create real image of the future system through the detailed identification of the elements of the system and their relationships.

The conceptual model is designed to provide an overview of the system by identifying business objects in the system. These models lack specific details but provide an overview of the content of the project and express how the data correlate with each other. The logical model represents a more detailed analogy of the conceptual model. This model fully captures and illustrates specific attributes and relationships. The model focuses mainly on business activities. Physical design of the system is created by physical model. This model is based on a logical model and deals with specific implementation of the system (Fig. 5) [2,3,6].

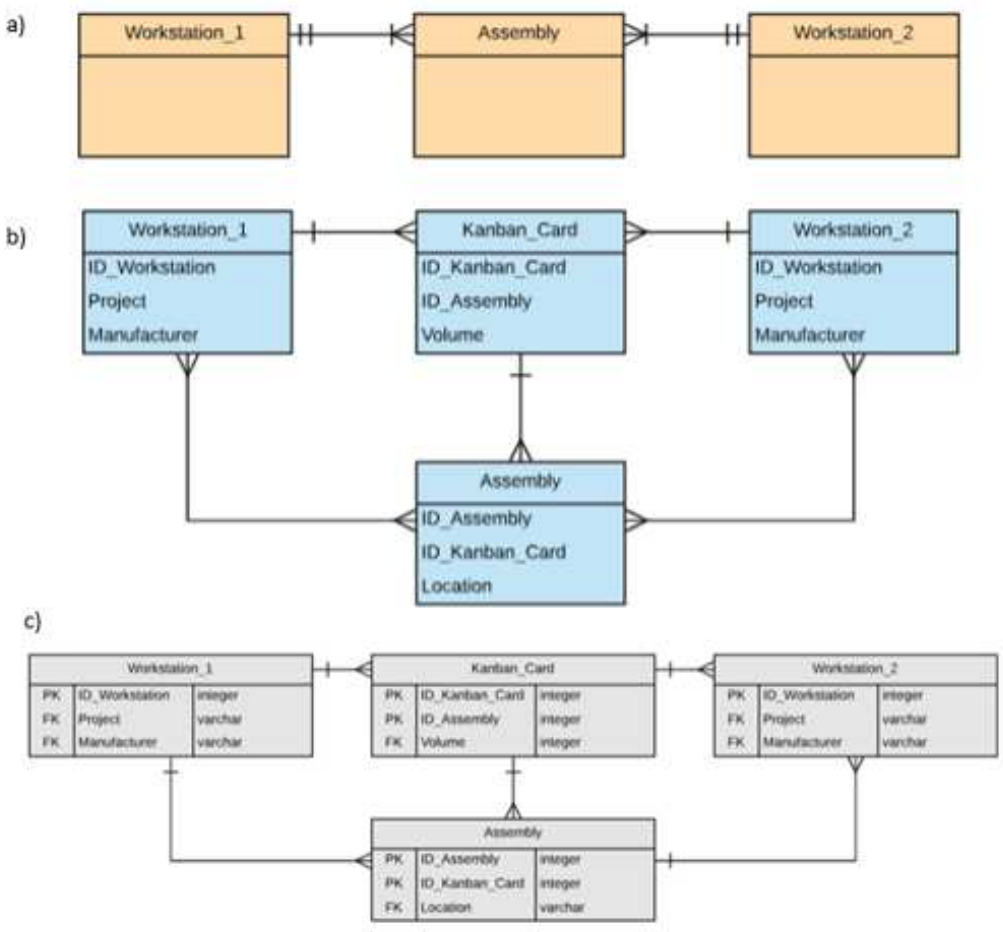

Figure 5 Using the ERD diagram to create an electronic Kanban system: a) conceptual model b) logical model c) physical model

3 Conclusion

Proper understanding and usage of Entity Relationship Diagram enables correct design of the electronic Kanban system as well as management and maintenance for the correct functioning of future enterprise information system.

Based on comparison of conceptual, logical and physical models used in Entity Relationship Diagram is possible to conclude that only physical model appears to be an appropriate tool for detailed design of electronic Kanban system. It captures a detailed description of the objects, its attributes and relationships within future information system.

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References

[1] BASL, J., BLAŽÍCEK, R.: *Podnikové informační systémy*, Praha, Grada, 2008. (Original in Czech)

[2] RAJU NAIK, M., VIJAYA KUMAR, E., UPENDER GOUD, B.: Electronic Kanban System, [Online], Available: http://www.ijsrp.org/research-paper-0313/ijsrp-p1528.pdf [06 Feb 2019], 2013.

[3] CASSIDY, A.: *A Practical Guide to Information Systems Strategic Planning*, Boca Raton, Auerbach Publications, 2006.

[4] STRAKA, M., LENORT, R., KHOURI, S., FELIKS, J.: Design of large-scale logistics systems using computer simulation hierarchic structure, *International Journal of Simulation Modelling*, Vol. 17, No. 1, pp. 105-118, 2018. doi:10.2507/IJSIMM17(1)422

[5] PIDD, M.: *Computer Simulation in Management Science*, 5th ed., Chichester, John Wiley & Sons, 2004.

[6] DEMOČ, V.: *Podnikové informačné systémy v teórii, vede a praxi*, Zvolen, Technická univerzita vo Zvolene, 2009. (Original in Slovak)

[7] GROOVER, M, P.: *Automation, Production Systems, and Computer-Integrated Manufacturing*, 3rd ed., Upper Saddle River, Prentice Hall, 2007.

[8] BUREŠ, V., CECH, P.: *Podniková informatika*, Hradec Králové, Gaudeamus, 2009. (Original in Czech)

[9] FEATHER, J., STURGES, P.: *International encyclopedia of information and library science*, London, Routledge, 2003.

Review process

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