Enhanced Data Models for Master and Transaction Data in ERP Systems – Unitary Structuring Approach

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Abstract*—In recent past, there seems to have an increased demand for improvements in current Enterprise Resource Planning (ERP) solutions. One potential area is enhancing existing master and transaction data models in ERP. This paper presents an integrated approach to represent both master and transaction data, which in turn helps improving applications within ERP system environment. Master and transaction data are modeled using unitary structures, integrating individual data elements and structures and associated functions. Functional tasks of transaction data are incorporated at structural level for improved planning and scheduling of components, such as component allocation and goods receipt processes in the production order cycle. Further, enhancement of master and transaction data can allow for forward planning of many components involved in various functional applications in ERP. Thus, potential improvements include simultaneous planning of many components (materials, resources, operations and project activities), forward planning across many applications and finite loading of resources as part of overall planning. The implementation of unitary structures in an ERP system can be carried out using additional links between existing data models. Once developed and implemented in an ERP system, data and information are visible and transactions associated with them are more flexible.

***Index Terms*—** Enterprise Resource Planning, Data Structures and Integration, Functional Applications, Production Planning.

I. Introduction

Enterprise Resource Planning (ERP) has been around for sometime, and has become increasingly popular among many organisations in the recent past, due to many reasons including the changes in competitive milieu brought about by intense rivalry among businesses, sophisticated customer expectations, etc. Over the last two decades, organisations, including Small and Medium Size Enterprises (SME) have moved to implementing some kind of ERP systems. ERP systems are business software packages that enable organisations to (i) integrate their business functions (sales, production, human resources, financial, purchasing, etc) throughout the enterprise, using integrated application modules based on business processes of best-business practices; (ii) share common data, information and knowledge throughout the entire enterprise; (iii) automate critical parts of its business processes; and (iv) generate and access information in real-time environment using a single database of all the basic and transaction data. As such, ERP systems have emerged as the core of successful data, information and knowledge management through integrated functional applications and the enterprise backbone of organisations. Further, the adoption of ERP systems are becoming more of supporting their businesses under ever changing environment of diminishing market shares, tough competition, ever increasing customer expectations and globalization.

Therefore, there seems to be strong potential for enhancing current practices of ERP, in particular functional applications for better planning, control and execution of many components. Enhancements can be two-fold: (i) improvements to the business process through best business practices and (ii) enhancement of master and transaction data for enhancing business processes and subsequently better information, flexibility and knowledge. Due to the limited scope of this research, improvements to business processes are not discussed here although indirect process improvements are highlighted.

There have been some research activities on data and data modeling aspects of applications in standalone or integrated systems [1]-[5]. Reference [1] provides a generic and adaptable data model for Manufacturing Execution Systems (MES) using traditional Entity Relationship (ER) modeling technique. This is limited to only data modeling and very specific to manufacturing execution. Reference [2] also looks mainly at data and provides selective bibliography of engineering information relevant for developing engineering information systems. There is a range of data and information relevant to functional applications which form the basis of ERP system, much more than just engineering information. Much attention has been directed at conceptual; data modeling of engineering information [3], [5]. Further, reference [6] proposes smart business object for web applications. Again, it is mainly data and no significance improvements to data being used in ERP with many applications. Apart from data modeling, data quality issues in ERP were the subject of some research activities [7]. Although these research activities attempted to improve data in ERP, almost of all of the activities mainly focus on scaled-down ERP for SMEs or selected applications from an information system perspective.

On the subject of business processes and their effect in ERP, there are a number of research publications to date. In early days, there have been various research papers on business process re-engineering (BPR) and their influence on ERP systems for improvements in applications [8]-[10]. More recently, reference [11], through a comprehensive literature review, shows that few tools are available for supporting manufacturing business process management and

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that, except for a few small-scale processes, BPR implementations in manufacturing have had limited success.

Recently, reference [12] concludes from a survey that there are many systems and tools such as ERP, Manufacturing Resource Planning (MRPII) available for planning and scheduling of resources within organisation, based on relational data, which do not provide a simplified, re-configurable approach to the ERP process suitable for SMEs. Their alternative approach to ERP system, based on the re-configurable characteristics of material objects and finance objects, lacks the recognition of event-driven process approach already embedded in ERP systems. Further, it is very narrow in perspective since it does not recognise the transaction data and associated cycles comparable to material objects with changes they suggested. However, their research reinforces the limitations of relational data within ERP systems for integration of many applications for the purpose of re-configuring and re-engineering business processes, in particular for SMEs. However, there is little or perhaps no research has been carried out in the area of enhancing both master and transaction data across many applications in ERP. Furthermore, all of the reported research activities are limited to improvements either selected applications and/or no improvements of data underlying those applications. Although reference [12] proposes an alternative approach to part of the problem, it requires lot of effort in implementing it within existing systems. Alternatively, this paper identifies existing data elements and structures and uses much of existing data for defining new data structures based on unitary structuring technique, with a view to enhancing performance and providing features such as re-configuration and re-engineering of processes across many applications.

In this research, improvements for master and transaction data are sought, with a view to applying those enhancements to associated applications in ERP system environment. Thus, the research is focusing on developing a novel approach to define individual master data and more importantly transaction data for effective and efficient planning and execution of functional applications. The approach is based on unitary structuring technique and incorporates all of the possible relationships between components. Currently, relational data in ERP systems do incorporate only hierarchical relationships, which limits planning and scheduling capabilities required by many applications, in particular when more than one application is involved.

This paper is organised as follows. Overview of data and data models in ERP system environment is presented first, followed by the unitary structuring approach for master and transaction data. Next, unitary structure-based master and transaction data in production planning (PP) module of ERP are outlined. Master and transaction data, based on unitary structuring technique, are presented for one of the selected business scenarios in PP module of ERP system for improved process functions within an ERP system environment. Finally, this paper concludes with research findings and recommendations for future research.

II. OVERVIEW OF DATA AND DATA MODELS IN ERP SYSTEM ENVIRONMENT

Data constitute a major part of any ERP system for executing many functional applications based on business processes across the entire organisation. In general, ERP system database is of type relational and is accessed and maintained through a set of Structured Query Language (SQL) queries embedded into business transactions. Further, data are uniquely defined for the enterprise, satisfying data integrity and real-time, and are populated with specific values at various organisational levels, to be used by many functions such as sales, production, logistics and maintenance. For example, material master is uniquely defined for the whole organisation and is available with relevant data fields for many functional departments of the organisation. ERP system database is mainly populated with master data, transaction data and organisational elements, in addition to other ERP specific information such as data logs and system source code. Although master data are defined for the whole organisation, certain master data are more relevant to specific functional applications, due to their usage in a particular area rather than by all functional areas of the organisation.

A. Master Data, Organisational Elements and Relationships

In general, master data are raw data and static in nature, and are maintained in the ERP system database and linked with related business processes through applications. In this research, data in ERP system is considered for further enhancements through integration and structural changes across many applications. Master data consist of data elements and structures where a data structure is a combination of data elements. Further, master data element is a set of data fields (attributes) and can have more than one instance of the same within an ERP system as records. On the other hand, data structures are either hierarchical or network, and but not combined due to the limitations of relational database. As a result, there are many individual data structures used in isolation over many applications requiring further integration at transaction data level. For example, hierarchical Bills of Materials (BOM) with only parent-component relationships and project networks with activity precedence (network links) require different planning techniques for planning of respective components. Due to this difference, Material Requirements Planning (MRP)'s explosion process using BOM cannot be combined with Critical Path Method (CPM) using project networks for simultaneous planning of materials, resources and activities, in particular with large manufacturing projects. Further, these limitations result in lack of forward planning and finite loading of resources. For example, in case of unplanned breakdown of a work centre during production, forward planning at the time of execution is not possible unless data structures are of the type closed-loop networks rather than hierarchical.

Master data are usually shared across many application modules of ERP system and are considered to be static, compared to transaction data which are dynamically changed during execution of business transactions. Both master data and organisational elements are used for many functional applications over business scenarios of the organisation. There are different data elements, structures and relationships across many functional applications of ERP system. Manufacturing planning and execution process cycle is one of the core business processes in ERP systems with a large number of data elements and structures including Materials, BOMs, Work Centres, Operations Routings and Cost Centres.

Material master, work centre and cost centre are data elements while operations routing (a set of activities) and BOMs (a structured set of materials) are two common data structures used in production planning module of ERP. Further, master data are defined at different orgnisational levels where the same master data can carry different values at different organisational levels of the organisation. Organisational levels divide an enterprise according to functional areas such as production, procurement, maintenance or purchasing. Common organisation elements in ERP system include company code, plant, sales organisation, distribution channel, storage location, etc. The client represents the whole organisation across national boundaries. A company code represents an independent accounting unit of the organisation. Each company code contains a balanced set of books. A plant can be one unit where it produces goods, renders services or makes goods available for distribution. The definition of a plant in an ERP system usually requires an address, a language, a country assignment and a workday calendar. On other hand, a storage location allows differentiation of material stocks within a plant. A storage location identifies where a material is stored. One or more storage locations can be assigned to a plant. Depending on the functional applications within ERP, there can be various hierarchical organisational structures of individual organisational elements.

The other important aspect of data is relationship between data elements and structures. Each data element and structure can have different relationships between components. Three common relationships between data elements include (i) Parent-component relationships in BOMs, (ii) Activity precedence in CPM network, and (iii) Operations to operations in standard operations routing while material master is a simple data element, BOM is a hierarchical structure. Operations routing, on the other hand, is usually a standard sequence of operations or a combination of both standard and parallel operations, which is similar to a CPM network. In the current ERP system settings, there is no integration of different data elements and structures at the database level. As a result, there is no single data structure with operations, materials and resources; and all the relevant relationships between them. Thus, integration of different data elements and structures can potentially enhance functions associated with current business transactions and eliminate the need for separate functions to be executed as part of complete business process of many transactions.

B. Transaction Data and Relationships with Applications

Business transactions in ERP systems are executed with relevant data inputs and result in various transaction data in the ERP system database. These transaction data are dynamic in nature and maintain dynamic links with associated master data, until such time the transaction data becomes independent of any changes to master data. Once these transaction data are isolated from associated master data, any subsequent changes to master data are not reflected on the transaction data. Further, these transaction data usually form execution phase of many functional applications. However, these transaction data lack the capability of forward planning required by many associated functions as a result of uncertain situations.

For example, production order makes copies of relevant data elements and structures at the time of its creation and associates with many other functions during the production order cycle. Those functions include scheduling of individual operations with finite loading of resources, availability check of both materials and capacities, goods issue for production and goods receipt after the completion of production. However, many functions are carried out manually, requiring some interfacing between static master data and dynamic scheduling data such as work centre loads and scheduled times. While transaction data maintains data integrity within transaction data without direct link with the master data, it lacks the capability of further planning with dynamic changes. When master data are integrated at the modeling level, component allocations can be part of data structures rather than a function during the production order cycle. Further, goods issues and receipts can be planned as part of order creation when production order is represented using an integrated data structure. Thus, those functions associated with transaction data can be simplified if the transaction data itself is created with integrated data structures rather than just a copy of individual data structures.

Table 1 provides a list of very common transaction data and associated master data in an ERP system environment. In each situation, transaction data is generated as a result of a functional transaction within a business process, implemented using a functional transaction with a set of data inputs and process parameters. These transaction data are also subject to further changes with a set of functions, mainly manual intervention during the process, similar to the production order process discussed above.

Table 1: Common transaction data in ERP system environment

Transaction Data	**Associated process/function and the module**	**Master data involved**
Planned order	MRP (MM, PP)	Material master and BOM
Production order	Production order creation (PP)	Material master(s), BOM, Operations routing, cost centre(s)
Purchase order	Purchase order creation (MM)	Material master, Vendor
Sales order	Sales order creation (SD)	Material master, Customer
Maintenance order	Maintenance order creation (PM)	Equipment, Task list, Work Centre

III. UNITARY STRUCTURING APPROACH FOR MASTER AND TRANSACTION DATA

In reference [13], CPM, MRP and Production Activity Control (PAC) were combined into a “unitary” (holistic) structuring technique which eliminated the limitations of the individual techniques. Thus, the basis for development of unitary structures for master and transaction data in ERP system environment, herein, was the unitary structure. These structures have been applied in many applications including engineering structures for maintenance [14], manufacturing and distribution networks in supply chain management [15] and more recently for manufacturing planning and control framework [16].

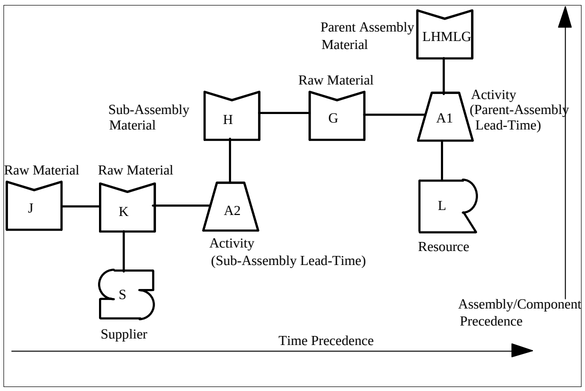

Figure 1: An Example of the Unitary Structure

In this research, these unitary structures are adopted for integration of hierarchical, network and sequential data elements and structures of ERP. The unitary structure enabled four types of components to be represented: materials, activities, resources and suppliers. Further, both hierarchical and network-type relationships are integrated using unitary structures. However, unlike conventional MRP, materials had no intrinsic lead-time – all timing data was contained in the activity components. Resources were associated with a particular activity and represented the work centre, tooling and/or labour required to execute the work required by the activity. Suppliers are used to model the purchasing of externally procured materials. An example of the unitary structure is shown in Fig. 1. In the terminology of the unitary structuring approach, the outline of the component icons appear as “M”, “A”, “R” and “S” which represent the first letter in the words Material, Activity, Resource and Supplier respectively. The unitary structure, shown in Fig. 1 could not be maintained in current ERP systems. However, the concept of integration of data structures at the structural level is introduced, in order to allow for benefits of unitary structures in ERP system environment.

A. Methodology for Integrating Various Data Elements and Structures in ERP System

Data models for data elements and structures in ERP are based on entity-relationship modeling with common hierarchical relationships and have been integrated at the database level. Each data element and structure consists of a number of attributes and corresponding records. Given these complexities (number of data elements, attributes and records), relationships and use of these data in planning and execution of one process cycle are too complex to be worked out manually, without the help of an integrated data structure. Many data elements and structures make it difficult to predict the complexities in terms of relationships, number of links and impact when individual data elements and structures are combined during business transaction processing. Further, any subsequent change to data models, required by business process change is visualized only when information is generated through reporting in functional applications.

Thus, integration of data elements and structures aims at enhancing the planning and execution of many business transactions as well as providing the flexibility and maintainability of many process cycles. Therefore, integration of data elements and structures at the structural level (at modeling stage) with associated functionalities can represent unified data models across various applications. These unified data models can be used to improve execution of transaction data through elimination of manual activities currently planned and executed in many functional areas. First, integration of master data is carried out using current and required relationships for functional applications in ERP. This means that master data are integrated with additional relationships and modeled using unitary structures, followed by unitary structures for transactional data. Main features of these models are (i) additional relationships due to integration, (ii) elimination of current interfacing between applications and more importantly (iii) data structures with many types of components and relationships.

Therefore, a methodology to enhance the data models currently adopted in ERP is proposed to support integration of various data elements and structures. The proposed methodology can be used to visualize the integrated data in terms of various data elements and relationships between components. Relationships are represented by links between components with appropriate precedence. Further, this can be used to enhance existing business processed to achieve the best planning and execution of all the components involved. Based on the above methodology for integrating different data elements and structures, a numerical example integrating hierarchical BOM with sequential operations routing for production planning is illustrated here.

IV. UNITARY STRUCTURE-BASED MASTER AND TRANSACTION DATA IN PRODUCTION PLANNING OF ERP SYSTEM

In order to demonstrate the representation of master and transaction data using unitary structures, a business scenario involving various master data and transaction data within production planning area of an ERP system is considered. The business scenario is a make-to-stock finished product with number of assemblies and raw materials, to be planned and executed using production management processes in an ERP system. Precisely, the finished product and assemblies are represented by multi-level BOMs and other required data include operations routings, work centres and cost centres attached to each work centre for costing purposes. Apart from master data described above, planning, control and execution involve various transaction data from planned order to production order.

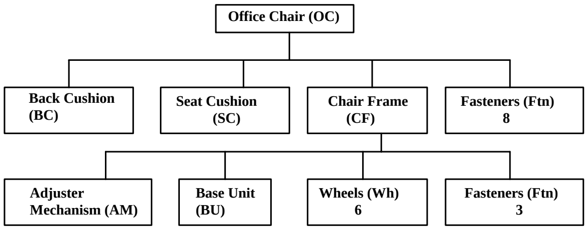

Figure 2: Product structure of the office chair

The production order is considered in details for enhancing the representation at the database level. It is assumed that the business scenario requires at least five key master data types: Materials, BOMs, Operations Routings, Work centres and Cost centres, for planning, control and execution of all components involved. Thus, following master data are assumed for one practical example of the assumed business scenario, identified as an office chair (model 1000-99). The product structure for the office chair is shown in Fig. 2.

Table 2: Operations and standard times for the office chair

Item Name	**Operation**	**Work Center**	**Setup (Min)**	**Labour (Min/Unit)**	**Machine (Min/Unit)**
Base Unit (BU)	Cutting (Cu)	T-M99	30	5	5
	Bending (Be)	T-M99	30	5	5
	Welding (We)	T-M99	15	10	10
	Painting (PBU)	1906	30	5	5
	Assembly of wheels (AW)	1904	30	10	5
	Inspection (IBU)	1720	15	5	
Adjuster Mechanism (AM)	Assembly with BU (ABU)	1904	15	10	10
	Painting AM (PAM)	1906	30	5	5
Chair frame (CF)	Inspection (ICF)	1720	15	5	
Back Cushion (BC)	Fabric Cut (FC1)	2050	15	5	5
	Assembly with CF (ABC)	1904	30	5	5
Seat Cushion (SC)	Fabric Cut (FC2)	2050	15	5	5
	Assembly with CF (ASC)	1904	15	5	5
Office Chair (OC)	Final Adjustment and Inspection (FAI)	1720	15	10	5

Table 3: Operations routing for Chair Frame:

Operation ID	**Description**	**Work Centre**	**Set-up (Min)**	**Machine (Min/Unit)**	**Labour (Min/Unit)**
Operation 10	Cutting (Cu)	T-M99	30	5	5
Operation 20	Bending (Be)	T-M99	30	5	5
Operation 20	Welding (We)	T-M99	15	10	10
Operation 40	Painting (PBU)	1906	30	5	5
Operation 50	Assembly of wheels (AW)	1904	30	10	5
Operation 60	Inspection (IBU)	1720	15	5	
Operation 70	Assembly with BU (ABU)	1904	15	10	10
Operation 80	Painting AM (PAM)	1906	30	5	5
Operation 90	Inspection (ICF)	1720	15	5	

Table 4: Operations routing for Office Chair

Operation ID	**Description**	**Work Centre**	**Set-up (Min)**	**Machine (Min/Unit)**	**Labour (Min/Unit)**
Operation 10	Fabric Cut (FC1)	2050	15	5	5
Operation 20	Assembly with CF (ABC)	1904	30	5	5
Operation 20	Fabric Cut (FC2)	2050	15	5	5
Operation 40	Assembly with CF (ASC)	1904	15	5	5
Operation 50	Final Adjustment and Inspection	1720	15	10	5

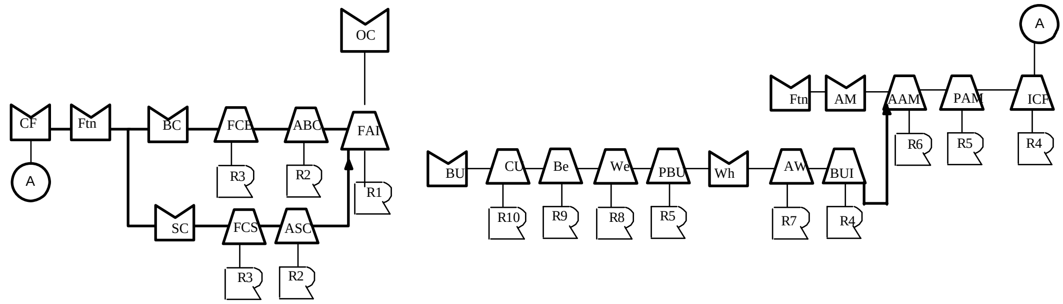

Figure 3: Unitary structure of BOM and Operations Routing for Office Chair

Table 5: Details of the unitary structure components of the office chair

Materials	Activities	Resources
OC Office Chair	CU Cutting	R1 – Assembly Inspector
CF Chair Frame	Be Bending	R2 – Fabric Machine/Operator 1
BC Back Cushion	We Welding	R3 – Fabric Machine/Operator 2
SC Seat Cushion	PBU Painting Base Unit	R4 – Inspector
AM Adjuster Mechanism	AW Assembly of Wheels	R5 – Painting Machine/Operator
BU Base Unit	BUI Base Unit Inspection	R6 – Assembly Machine/Operator1
Wh Wheels	AAM Assembly of Adj. Mechanism	R7 – Assembly Machine/Operator2
Ftn Fasteners	PAM Painting of Adj. Mechanism	R8 – Welding Machine/Operator
	FCB Back Cushion Fabric Cut	R9 – Bending Machine/Operator
	FCS Seat Cushion Fabric Cut	R10 – Cutting Machine/Operator
	ABC Assembly of Fabric in BC	
	ASC Assembly of Fabric in SC	
	FAI Final Adj. and Inspection	

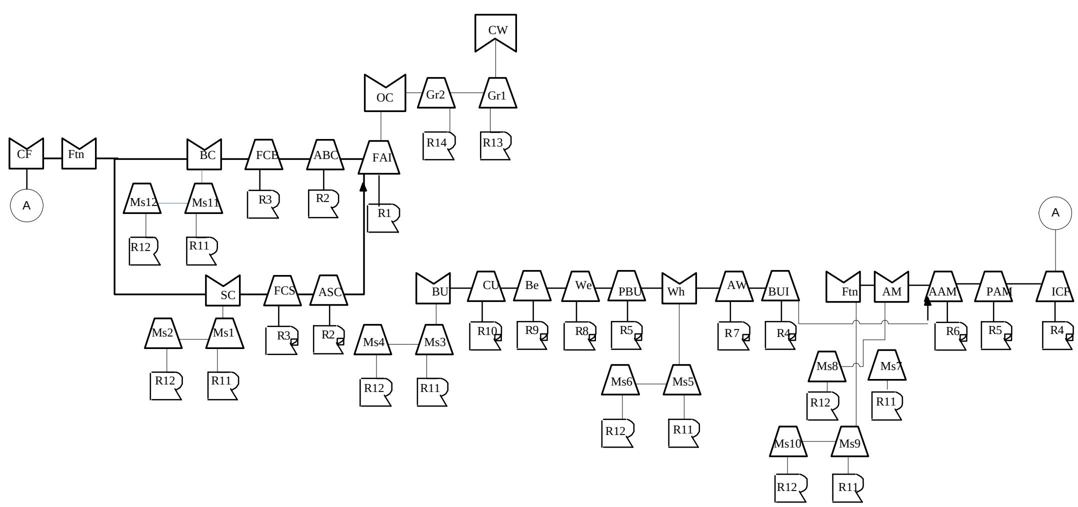

Figure 4: Unitary structure-based production order for the office chair

Operations associated with the production of the office chair are shown in Table 2. Thus, the product structure and the operations given can be set in ERP systems using appropriate BOMs and Operations routings respectively. Since ERP system usually maintains single-level BOMs, there are two operations routings: one for each single-level BOM of the product structure. The details of resulting operations routings are shown in Tables 3 and 4.

In order to allow for all the correct components are available for the relevant operation(s), components of the BOM for office chair can be assigned to appropriate operation(s) using component allocation functionality. In this case, Base Unit is assigned to operations 10 by default. Further, Fasters and Adjuster mechanism are assigned to Operation 70 while wheels are assigned to operation 50.

Similar to component allocation in Base Unit, components are required to be assigned into appropriate operations using

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component allocation functionality. Thus, back cushion is assigned to operation 10, seat cushion is assigned to operation 30 and Fasteners are assigned to operation 20. It is evidence from the above that all of the key data can be maintained using various levels for further processing during appropriate planning, control and execution processes. Materials, work centres and cost centres have no implications during transactions since they are simply values against other data within transaction data. However, BOMs have some implications when combined at the time of production order creation. Apart from those two data structures, additional functions come into the picture when a production order is created using such data elements and structures. Additional functions include component allocations, goods issues, good receipts and order settlement. However, the production order as a transaction data at this level does not have capability of adding those functions into a structured transaction data rather the information is copied into the order. Thus, the aspect data being copied rather than directly linked to the database, and need for separate functions during the order creation and beyond limits the capabilities of smooth processing of production orders and/or other transaction data created with these data elements. However, these issues can be handled using unitary structure-based transaction data.

Master data described above are candidates for integrated master data so that planning, control and execution can be streamlined and enhanced using additional functionality. For example, integrated operations routing with BOMs can eliminate component allocations in production order cycle. Further, longer lead times associated with sequential operations can be reduced when operations are integrated into BOMs using operations routing of both sequential and parallel operations. Thus, master data described above for this business scenario are integrated using unitary structures and presented next.

A. Master Data Integration using Unitary Structures

Currently, this scenario can be planned, controlled and executed using traditional ERP systems. However, there is lack of simultaneous planning, forward planning and finite capacity planning capabilities due to lack of true integration of data at the database level and inflexibility of planning techniques. As a first step of improvements for the planning, control and execution process, hierarchical BOM shown in Fig. 2 is integrated with sequential operations routing (Table 3) to make a unitary structure-based one data structure. The resulting data structure is shown in Fig. 3. Details of unitary structure components are shown in Table 5.

It can be noted from Fig. 3 that original two routings and two BOMs are combined into one data structure. Further, it also provides built-in component allocation as part of the structure rather than separate activity in operations routing. In addition to integrated data structures, transaction data generated from this data can also be represented by unitary structure for effective execution of such transaction data. In many situations, transaction data are combined with various other events and associated functions outside the functional application the original process belongs. Further, there are many activities and resources in such functions and events, which require synchronous planning of all involved. For example, production order creation process and associated cycle involves various other functions including goods movement at two levels: good issues to the production and good receipts from production. These functions/tasks are required to be carried out at the correct time for timely completion of the production order. Using unitary structure, these functions/tasks can be incorporated and planned for better outcome of the overall process rather than manual intervention required by current systems.

B. Integrated Transaction Data using Unitary Structures

For the purpose of demonstration, it is assumed that a production order is created and associated good movements functions are incorporated into the structure. Thus, resulting production order with relevant good movement functions, based on the above data structure is shown in Fig. 4. It can be seen from Fig. 4 that unitary structure-based transaction data is visible in terms of all components involved. In this particular case, the production order is shown with key activities of good movements at various points. All the good movement related components are shown in red colour. All the raw materials are part of good issues to the shop floor while the finished product is associated with the good receipt activity at the top. For example, base unit as a raw material is shown with two additional activities and resources where it is subject to good issue from the warehouse. This can be further extended by incorporating associated field warehouses at each good issue location of the structure. At the top, goods are received at the central warehouse denoted by CW.

The benefit of having this structure is that functions usually carried out at different times during the production order cycle are now replaced by relevant activities/tasks and associated resources and are connected through data structures rather than just a copy of such information as currently being done. Further, this enables planning of all involved at the time of production order creation. For the purpose of enhanced planning associated with the enhanced transaction data, we need combined planning and scheduling techniques. Such combined planning and scheduling techniques can even be designed for process optimization which is not part of business process solutions in many ERP systems. On the subject of combined planning and scheduling techniques, reference [16] designed required algorithms for planning and scheduling of such structures across SCM using ERP system environment.

In addition to integration of components in the original operations routings and bills of materials for the production order, there are additional activities and resources due to functionalities associated with the production order. For the simplicity, all the activities are attached with common resource components (R11 and R12) except for the final good receipt function where resources are labeled R13 and R14. Further, raw materials can be attached with suppliers with necessary tasks and resources for further enhancement of data structures and resulting production order. The inclusion of such additional components can facilitate forward planning of the entire structure, taking not only materials but also resources. Thus, the integration of data structures for both master and transaction data provide flexibility of dynamically changing situation within many planning, control and execution cycles and allows critical path to be dynamically decided based not only on activities but also on availability of materials and resources during the execution phase. The methodology for planning these structures is not discussed here since it is beyond the scope of this paper.

V. CONCLUSIONS

This paper identified the need for an integrated approach for data beyond traditional relational data principles. It also identified the improvements in data can lead to improvements in business process improvements. Recent developments in data in ERP system environment showed that many researchers and practitioners attempted to improve individual data elements and structures rather than integration at the database level for better process performance. This paper presented an integrated approach for data integration using unitary structure data models. The approach is demonstrated using a numerical example drawn from one of the application modules in ERP system environment. It has been shown that the proposed approach integrates various data elements and structures and incorporates additional functions for business transactions and eliminates the need for manual interfacing between data and transaction data during transaction data processing. It is shown that the resulting data integration within ERP system environment can provide streamlined transactions beyond process integration when implemented in an existing ERP system environment. In addition, it is capable of providing visibility, flexibility and maintainability for further improvements, in particular in process optimization using enhanced data models.

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