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WBS Data Analysis Method Based on Information Supply Chain

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Abstract: In order to realize the core guiding role of WBS (Work Breakdown Structure) during a complex product project business process and to make it become the real deliverer of effective information, this study starts from the analysis of the information supply chain when a WBS starts and based on the perspective of Mapreduce programming model, establishes a mode which determines the unstable links of the information supply chain by excavating the historical data. Furthermore, this study proposes the idea of tracing to the source of the unstable links, breaks the plight of WBS optimization under the causal perspective and constructs a method which can obtain the recommendations of WBS optimization by finding the correlations between the deviation information and the corresponding dimension information of WBS.

Key words: Complex product manufacturing project, work breakdown structure, big data analytics, information supply chain

INTRODUCTION

The efficiency of complex products manufacturing project depends on the efficiency of work division directly. However, the complexity of the complex products project led to the preparation of the WBS is always biased towards engineering. And based on the slow accumulation of the experience, the use of WBS preparation exists some chronic illnesses which reflected in the adjustment and refinement during the project implementation process, the reduction of the organization efficiency of the task involved between packages, the delays of the schedule and so on. Some scholars have conducted researches on how to construct WBS from the perspective of causal analysis (Hashemi and Emamizadeh, 2007; Li and Ren, 2013; He *et al*., 2011; Ren *et al*., 2013b; Ren and Cao, 2013; Lv and Wang, 2009) and some scholars have conducted researches WBS optimization (Lee *et al*., 2010; Danilovic, 2006; Ren *et al*., 2013a; Yu *et al*., 2009). As it involves a lot of information and its heterogeneity, the causal relationship between them is difficult to be captured. Accordance with IBM's "3A5 step" ideas, access to information (Align) and obtain insight (Anticipate) allows us learn (Learn) from the feedback of the previous business and to improve the information-based decision-making processes. At present, whether the project's main complex product manufacturing units, cooperative units or types of providers, they all generate and use a large amount of data during the life cycle of manufactured project. If starting from the analysis of these data, finding out the problems and the links between work breakdowns, the information integration WBS can be established well directs at the requirements of the project manufacturing.

Although get return from the chaotic big data has often been seen as a protracted thing, the emergence of cloud computing made the fast return of the era of big data become possible. It requires us to re-sort ideas: In complex project manufacturing management process, what is the information supply chain which is started by WBS, which link's information is unstable, what data does these links have, what changes do these data have, what is the relationship between these changes and directive information of WBS. Excavating the correlation between them can provide optimization suggestions for the achievement of information integration WBS.

Based on this line of thought, this study studies on the methods which can trace to the source of and have an insight into the date to find out the corresponding correlations.

STARTUP INFORMATION SUPPLY CHAIN BY WBS

When a work breakdown for a complex products manufacturing project is conducted, the 100% principles is to be followed. Each task package is identified uniquely

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and the work breakdown results can be expressed into sextuple. WBS = (Nu, O, S, T, C, R), Nu is the multilevel code set of WBS to identify each task package uniquely. O is the set of organizations which undertake the tasks (Oij), with the subscript represents the organization position in the entire organization, i represents the level of the organization, j represents the position of the i-th layer. S is a collection of services (Sij), such as product design services, system design services, parts manufacturing services, products transportation services as well as descriptions of the required service resources, with the subscript represents the service position in the whole service system, i represents the level of the service, j represents the position of the i-th layer. T is a collection of duration (Ti), which is used to describe duration and relative start and completion time, with the subscript represents the time period position in the entire project cycle. C is the set of cost (Cij), which is based on the work budget, with the subscript represents the cost position which based on a financial point in the overall cost system, i represents the type of cost, j represents the detail of the i-th class. R is the set of relationships between the tasks (Rij), it means the relationships between the work package WPi and WPj, including time interval sequence, immediately after the former tight, overlapping, during containing, same time starting and same time ending, parallel and so on.

The result of WBS is the basis and foundation of the project planning and progress monitoring (Boysen and Fliedner, 2008; Hu *et al*., 2008). The subsequent design (Wang *et al*., 2009), procurement, processing, assembly and other business activities can be started by delivered WP start and based on the information of its tuple to match the corresponding object and resources to complete the task. In this process, the order correlations will occur between the different WPs. There are many associations between WP and organizational security, service requirements, schedule, cost structure and other inter-dimensional information. At the same time, information within each dimension itself also has correlated. All these lead to during the implementation of the information related and process extended according to the work breakdown results and then gradually formed the life cycle mesh information supply chain of project manufacturing, as shown in Fig. 1.

FIND OUT THE UNSTABLE LINK OF THE INFORMATION SUPPLY CHAIN

Due to the large number of WP items in complex product project and of relationships between WPs, it is hard to do enough comprehensive and in-depth in the

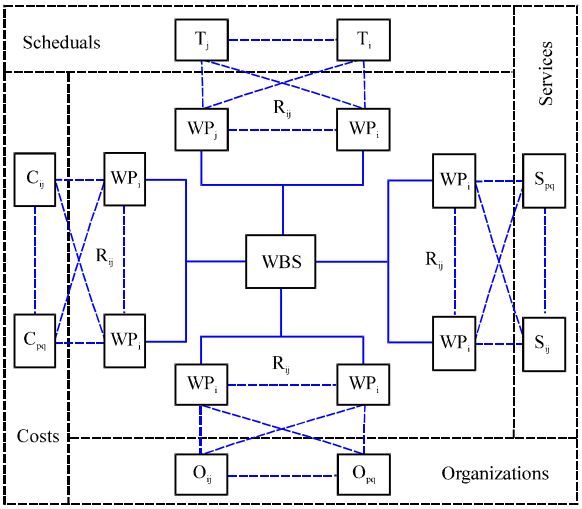

Fig. 1: Mesh information supply chain started by WBS

integrity and consistency of work demarcation and the information contained by work packages. So, the project activities commenced in accordance with the work breakdown results can not be completely an orderly manner in many cases and often requires intervention with scheduling. The message conflict area occurs in information supply chain which involves many types and large number of nodes, we call it unstable link. In order to ferret out the unstable link, a large number of data which involved RDBMS, text, temporary scheduling records related to information supply chains needs to be excavated. Data sources include database, word, excel, laptops, sensors and so on.

To be able to carry out parallel computing of large-scale data, the data analysis process of unstable link excavating uses the MapReduce programming ideas (Dean and Ghemawat, 2008; Lin and Dyer, 2010; White, 2012). And historical data is processed in cloud computing environment and the data analysis process is shown in Fig. 2, as the following steps:

- Input Format module is responsible for the preprocessing of database, word, excel, laptops, sensors and other historical data to match the input definition of JobConfig
- The input file will be cut into logical input (InputSplit), the records which have been cut into inputsplit will be handled by RecordReader and output to the Map
- Map execute defined Map logic, Output processed key-value pairs into a temporary intermediate files. And then combine will be conducted to reduce the amount of data transferred in the subsequent process

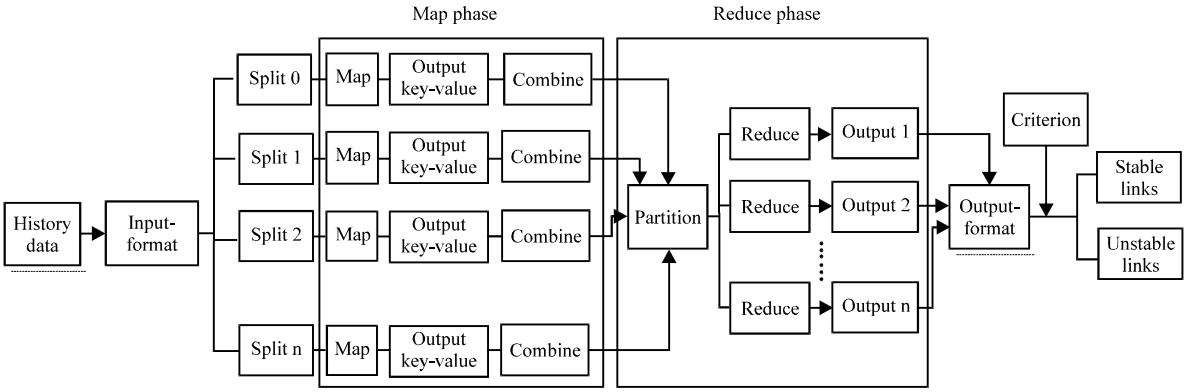

Fig. 2: Data analysis process of excavating unstable links

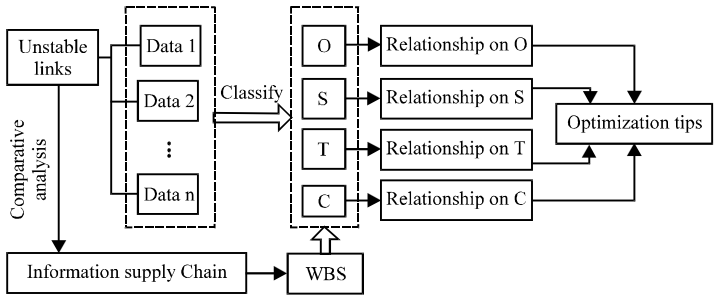

Fig. 3: Excavating the correlation between the unstable link data and WBS

- Partition is followed. The main role of partition is to specify the MAP results be processed by a Reduce and each Reduce will have a separate output file
- Reduce implements the specific business logic. That is user-written data processing operations to get results and the processing result will be output to OutputFormat
- According to the result of the analysis operation, in accordance with the judgment basis, such as the frequency of the data changes, degree, etc., stable and unstable links divided

ANALYSIS OF THE UNSTABLE LINK DATA

To make WBS results more reasonable, after finding the unstable links in the information supply chain, it need to establish correlation between the data included in the unstable links and the WBS by tracing to the source. It is as shown in Fig. 3.

At this stage, the reasons of the data change need to be classified and to be contrasted with the information in each dimension of WBS as follows:

- Determine the correspondence between unstable link and information supply chain node
- Achieve unstable data report about when, where, what, how many and so on by contrasting with the information supply chain nodes
- Unstable data will be classified into four deviation dimensions, as organizational maintenance, service maintenance, schedule maintenance and cost maintenance
- The unstable data and WBS will be contrasted according to four dimensions by tracing to the source and then obtain the correlation between the deviation information of O, S, T, C and the corresponding dimension information of WBS in unstable link
- According to the comparative analysis of the results, the optimal proposal which can be used to guide future project work breakdown will be obtained

CONCLUSION

Who has the data and who wins the world. But many companies are still just heap the information together

simply. They only take it as the necessary information which need to be saved to meet the corporate governance rules, instead of having them as a tool for strategic change. Based on the manufacturing projects which enterprises engaged in, there is a certain similarity and cognition at a period of time. Based on the description of the WBS information supply chain start-up, this study uses the guiding ideology of MapReduce programming model, collects historical data, conducts map and reduce operations, obtains the output results and divide the stable and unstable link according to the pre-set basis to judge. Through tracing to the source of the unstable link, this study finds the correlations between the deviation information and the corresponding dimension information of WBS and WBS optimization recommendations will be obtained.

It should be noted, the choice of data collection will affect the efficiency and accuracy of operation. At the same time, complex product manufacturing projects are generally mission-critical projects, the judgments of unstable link in the information supply chain are not the same in different companies, it need to be set according to the project's organizational complexity and technical complexity specifically.

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