Research and Application of Digital Twin in Steelmaking Production Scheduling

Qiaoshun Wu[1], Cheng Chen[1], Kun Pi[1] and Haibo Peng[2*]

[1]Yunnan Kungang Electronic Information Technology Co, Ltd, Yunnan Kunming 650302

[2]Kunming University of Science and Technology, Yunnan Kunming 650302

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Abstract: With the increasing number of embedded devices connected by factory manufacturing process, steelmaking process management is one of the important contents of enterprise production management, and it is a technical means to ensure the normal operation of iron and steel production. [1] in the field of industrial automation, with the transfer of applications and services to unmanned, the main modes of data and operation location have been changed, which has also brought subversive changes to the field of embedded equipment. For example, with the intelligence of embedded products and typical IT components in many industrial automation fields, such as manufacturing execution systems and production planning systems, and the increasing degree of connectivity, production equipment will no longer be single and independent in the past. The individual. The main part of this paper is digital twin system in steelmaking production scheduling, including terminal module, planning module, Gantt chart module, data storage module and so on. Among them, according to the actual production line equipment situation, the Gantt chart module will draw the status diagram of all the equipment of the production line, and map out the current production furnace information. According to the production situation of each process, the starting production time and the end time of the furnace number in each process will be calculated, and drawn out in the diagram. The system can make steelmaking engineers intuitionistic, complete and effective planning, organization of production and transmission of production information between production positions. It makes the production in steelmaking process accurate, effective and raw. The production process record is clear, complete and accurate, and the level of production process monitoring can be improved, so that the production personnel can accurately grasp the production rhythm, control the production quality and improve the production level.[2]

Foreword

At present, the production planning arrangement between steelmaking processes in steelmaking enterprises mainly depends on manual mode, through the dispatch room personnel manually confirm the end time of each process, and then notify the next process operator to prepare to receive molten steel and carry on the operation. [3] the operators of each process cannot understand the production arrangement of the upper and lower processes in time and accurately, and the production data information. When the operator needs to know this information, the relevant information can only be obtained by telephone contact with the general transfer or up and down process operators. The main disadvantages of this method are that the effectiveness of production planning is not high, and the manual arrangement of production is not high. The production conditions of all processes cannot be fully considered, and the production time can only be roughly estimated. In the actual production, the plan cannot be carried out accurately. [4]dispatchers cannot grasp the real-time production situation of each process in time, and cannot accurately schedule the production. For each process operator, cannot understand its upper and lower process production, lack of effective communication. For the actual situation of production, there is a lack of complete and effective records.[5] Accurate and reliable data cannot be provided for production situation analysis. Therefore, it is very necessary to develop a management system to solve the above problems. [6]

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1 System Design

The digital twin system in steelmaking production scheduling includes terminal module, planning module, Gantt chart module and data storage module, in which the terminal module is used for operators to operate the system, and the planning module is used for making production plan and storing it in the data storage module. Gantt chart module: used to transfer the situation of each process equipment from the data storage module and draw the real-time situation of the production line, according to the real-time situation of the production site to draw the plan information; data storage module: used to store steelmaking process information. As a management system specially developed for steelmaking process, the system combines steelmaking process with rational process design and joint application of system modules. To overcome the difficulties of steelmaking production planning, production arrangement, inter-process information flow and process production data recording in iron and steel enterprises, the problem of isolated information of each process in steelmaking plant has been solved, and the planning can be arranged intuitively, completely and effectively, the production can be organized and the production information can be transmitted among the production positions. So that steelmaking production is accurate, effective, clear, complete and accurate production process records, improve the production process monitoring level, so that the production personnel can accurately grasp the production rhythm, control the production quality and improve the production level.

1.1Module Flow Diagram

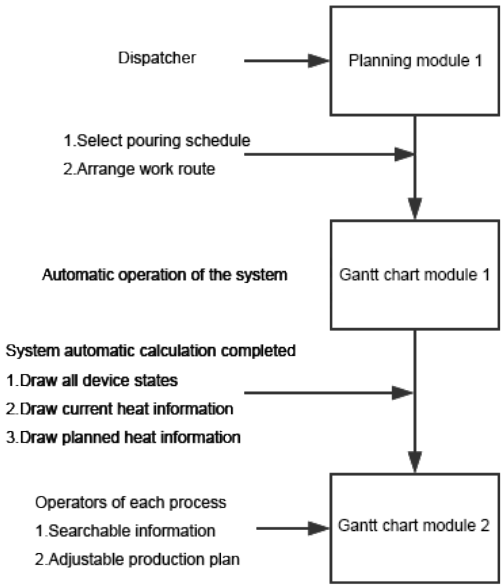

Fig1 Module Flow Diagram

2. Concrete Realization

The following is a further explanation of the system combined with the figure. In the digital twin system, the production plan described in the planning module is to set up the process route from the pouring plan. The process route is whether to select converter number, whether to blow argon, whether to pass through refining furnace, which casting machine, casting order, casting grade, specification, casting speed and hot delivery. The process equipment described in the Gantt chart module is electricity consumption, gas consumption, water consumption, equipment speed and equipment operation mode. The real-time situation of the production site described in the Gantt chart module is molten steel temperature, molten steel composition, molten steel weight, feeding consumption and pouring number. and furnace number. The plan information described in the Gantt chart module is the specific time arrangement of the converter to be produced and the furnace to be produced, the argon blowing station to be produced and the furnace to be produced, the refining

furnace to be produced and the furnace to be produced and the continuous casting machine to be produced and the furnace to be produced. The Gantt chart module automatically calculates the production schedule of each process according to the information of schedule, production conditions, process requirements, production order, maintenance plan, raw material supply and equipment operation, etc. Pouring production arrangement, argon blowing furnace times and pouring production arrangements, refining furnace and pouring production arrangements and casting machine furnace and pouring production arrangements; The picture includes the operation picture of all process equipment in steelmaking production, running real-time data, planning information, pouring information, furnace production process, converter current production furnace detail information, argon blowing current production furnace detail information, refining current production furnace detail information and continuous casting current production furnace detail information. The steelmaking process information described in the data storage module is the running state of each equipment at every time, the water consumption of each equipment at every time, the electricity consumption of each equipment at every time, and the power consumption of each equipment at every time. Gas consumption, each equipment running speed, angle, pressure, station and other information.

2.1Application Method of Digital Twin System.

2.1.1The dispatcher adds the production plan, selects the pouring plan in the adding production plan page, and then arranges the operation route for the pouring plan, selects the converter number from the converter, determines whether the argon blowing is passed, whether it passes through the refining furnace, which casting machine is finally put on, and the order of the furnace is determined.

2.1.2According to the actual production line equipment, the Gantt chart module will draw the status diagram of all the equipment of the production line, and map out the current production furnace information.

2.1.3After adding the production plan, the Gantt chart module will calculate the starting production time and the end time of the furnace number in each process according to the production situation of each process, and draw it out in the diagram.

2.1.4If the production route is changed temporarily, the furnace schedule can be adjusted directly in the diagram.

2.1.5If the furnace schedule changes, or the pouring plan changes, the furnace number or pouring information can be deleted directly in the diagram.

2.2system Characteristics

2.2.1The planning module is simple to operate and the production plan is clear.

2.2.2Gantt chart module can reflect the current production situation and running state of each equipment in real time.

2.2.3Gantt chart module can reflect the production planning in real time.

2.2.4 Gantt chart module data display clear, clear, complete. All the information is clear at a glance.

2.2.5 the Gantt chart module can be modified directly in the data chart to delete the scheduled task.

2.3The Concrete Realization Method is as Follows:

2.3.1When the planner has made the production plan, the dispatcher can arrange the furnace production task according to the production plan in the planning module.

2.3.2The furnace production arrangement includes the furnace number, the starting production time, the furnace process route, whether to pass through the argon station, whether to go through the refining furnace, which casting machine to go on and the sequence of pouring times, and so on.

2.3.3 The Gantt chart module will collect the running data of each process equipment in real time, and then automatically judge the current production status of the equipment and draw it out in the form of pictures.

2.3.4 The Gantt chart module decomposes the scheduled furnace production tasks into each

process Then, according to the production situation of the process, arrange the production task in turn.

2.3.5The arrangement of each furnace production plan can be intuitively queried on the Gantt chart module.

3. Conclusion

The purpose of the system is to overcome the difficulties of steelmaking planning, production arrangement, inter-process information flow and process production data recording in iron and steel enterprises, to solve the problem of isolated information island in each process in steelmaking plants, and to provide a production scheduling method suitable for steelmaking production in iron and steel enterprises. [7] the scheduling mode is mainly based on the real-time production of each process in production by computer terminals. The production plan is decomposed and arranged to each process, and the production arrangement of each production process is clearly marked on the Gantt chart based on the timeline and the horizontal rectangle, and the current production trends of each process are explained by auxiliary pictures and words. So that all the pouring production planning information, furnace information and real-time dynamic information of each process production can be transmitted to steelmaking dispatcher and all production post operators in time, accurately and completely, to solve the problem of information isolated island which communication is not smooth and not timely in the past, and to open up the information channel. Let the production situation be clear at a glance. [8]

The technical scheme adopted by the system to solve its technical problems is that the system is composed of planning module and Gantt chart module. According to the production planning task, in the planning module, draw up the pouring plan and group pouring, set the planned process route, and arrange the furnace production. Gantt chart module according to the adjustment The plan generated by degree automatically calculates the production time schedule of each process according to the information such as planning arrangement, production conditions, process requirements and so on, and draws the planned results dynamically on the screen. [9]the screen includes the operation picture of all process equipment in steelmaking production, real-time data, planning information, pouring information, furnace production process and so on. All pouring information, furnace production situation in the form of Gantt chart block, with the timeline and the current timeline, the screen can intuitively, clearly and accurately display all the main information of steelmaking production. To provide accurate basis for scheduling and production. The beneficial effect of the system is that it can be intuitionistic. Complete and effectively arrange planning, organize production and transfer production information between production positions. Make steelmaking production accurate, effective, clear, complete and accurate production process records, improve the level of production process monitoring, so that the production personnel can accurately grasp the production rhythm, control the production quality, improve the production level.[10]

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