THE STUDY OF DIGITAL REMANUFACTURING ENGINEERING FOR VEHICLE ENGINES

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Abstract: At present，the domestic remanufacturing of vehicle engines is still at the primary stage, there are only two engine remanufacturing company, most of which productivity and information is low . In this paper, the study of digital remanufacturing engineering for vehicle engines is proposed, the architecture, process planning system and technological process was established based on the information platform of digital software （eM-power）. At last, it analyses the digital remanufacturing process of crankshaft.

Keywords: eM-power; remanufacturing; architecture; process planning; technological process

1 Forward

At present, with the development of global economics, the competition of manufacturing company of which index are the exploitation time，Quality, Cost and Service of product is gradually intensive. Manufacture technology has changed from substance manufacture to information manufacture; the value of information plays an increasingly percentage in product. With the development of information technology, many new manufacture idea and manufacture system are proposed. The mode of digital manufacture is appearing.

At present, although the domestic remanufacturing of vehicle engines have got more developed, but it is still at the primary stage, most of which productivity and information is low. We improve our remanufacturing information level with the experience from digital manufacturing. Digital is an important expression form of information. Digital remanufacturing basing on digital factory technology has changed tradition remanufacturing in-site working. Digital remanufacturing is a great reformation of remanufacturing engineering based on remanufacturing theory, which is fused by digital technology and remanufacturing technology and is the core of advanced remanufacturing technology[1]. Digital remanufacturing engineering for vehicle is the recovery and reuse of old engines combining with digital factory technology. It not only improves the level of productivity, but also promotes productivity and informationization level in remanufacturing.

2 Digital remanufacturing engineering for vehicle engine

2.1 The architecture of digital remanufacturing engineering for vehicle engine

Digital remanufacturing for engine is a new concept. It combined computer integrated manufacturing technology according to the request of user, collecting the information of resource, analyzing and planning the information of engine and technology with the support of high level decision making system, implementing the simulation of engine remanufacturing and repairing the engine quickly according to users' requirements with the application quick-recovery technology, remanufacturing technology, database technology, network and multimedia technology. That is to say, digital remanufacturing for engine is in the digital space which is built by precision measuring and digital describing in the remanufacturing process. So far, there is no scholar have built the architecture of digital remanufacturing engineering. But some domestic and foreign scholars have built digital manufacture system architecture in different angles. We built architecture of digital remanufacturing with their experience of digital manufacture.Fig.1 shows the architecture of digital remanufacturing engineering for vehicle engine[2]. Its architecture includes scientific theory and scientific foundation of engine digital remanufacturing, the key technology of digital remanufacturing, the application domain of engine digital remanufacturing and the implementation network of digital remanufacturing.

Digital remanufacturing engineering for vehicle engine is based on manufacturing science, information science, management science and control science, and fused by foundation science and theory.

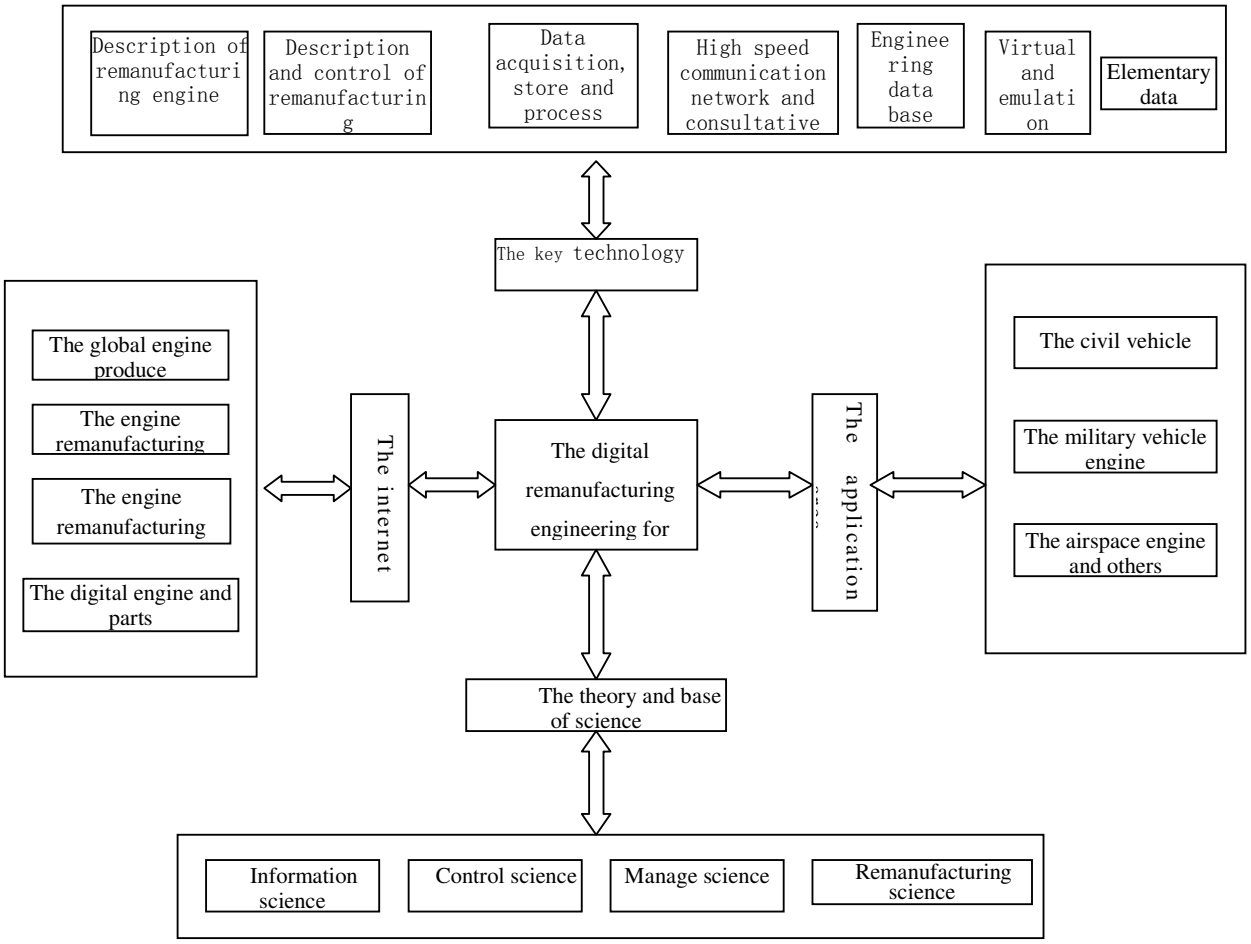

Fig 1: The architecture of digital remanufacturing engineering for vehicle engine

The key technology of digital remanufacturing engineering for vehicle engine include the technology of engine description, the expression and control technology of remanufacturing process, the data acquaint of remanufacturing, storing and processing technology, the network of high speed communication and consultative technology, engineering database technology, virtual and simulation technology and elementary data technology. Details as follow:

1) The technology of engine description. It means how use the digital technology to describe the information of engine, it includes the standard of description and expression, such as STEP is a representative technology and standard of description for product.

2) The description and control technology of remanufacturing process. It includes how to description and control various determinacy and nondeterminancy remanufacturing process, for example, the nondeterminancy remanufacturing process include market reclamation decision.

3) Remanufacturing data acquisition, data store and data process. It includes collection, description, store and application of remanufacturing.

4) High speed communication network and consultative technology. Such as design synergism in the condition of allomicrite and isomery, needs the support of high speed communication network and consultative.

5) Engineering data base technology. In the process of digital remanufacturing relate to lots of problem about store and administer engineering data, so far there was no very adequate data base technology meet corresponding requirement.

6) Virtual and stimulation technology. It includes simulation of remanufacturing process, digital model machine, and virtual reality.

7) Elementary data. Elementary data is the data of data, by means of it we can know the name and usage of related data and so on

Digital remanufacturing engineering for vehicle engine can be completed in different layers and different network environments. In the same industry it can be implementation in internet or intranet; in a company it can be implementation stay bearing by intranet and local area network. To a concrete product, it can be implementationed stay bearing by network and digital technology in all life cycle of product.

2.2 The process planning system of digital remanufacturing engineering for vehicle engine

Technological planning is the most important part of manufacturing or remanufacturing. The process planning of digital remanufacturing engineering for vehicle engine

means on the information platform of digital remanufacturing to plan engine remanufacturing process, that is based on digital manufacturing resource and technological planning, through realize remanufacturing character to plan process for engine remanufacturing. The digital process planning means to plan process planning and design remanufacturing production line at the same time and discovery the defect of process planning and correct it as early as possible, It tests the effect of process planning and the design of production line with the technology of production line simulation, and implement the effective integration of process planning, design of remanufacturing production line and the effective data of different simulation parts. That means built the integrated simulation platform of digital production line[3]. Fig.2 shows the technological planning system.

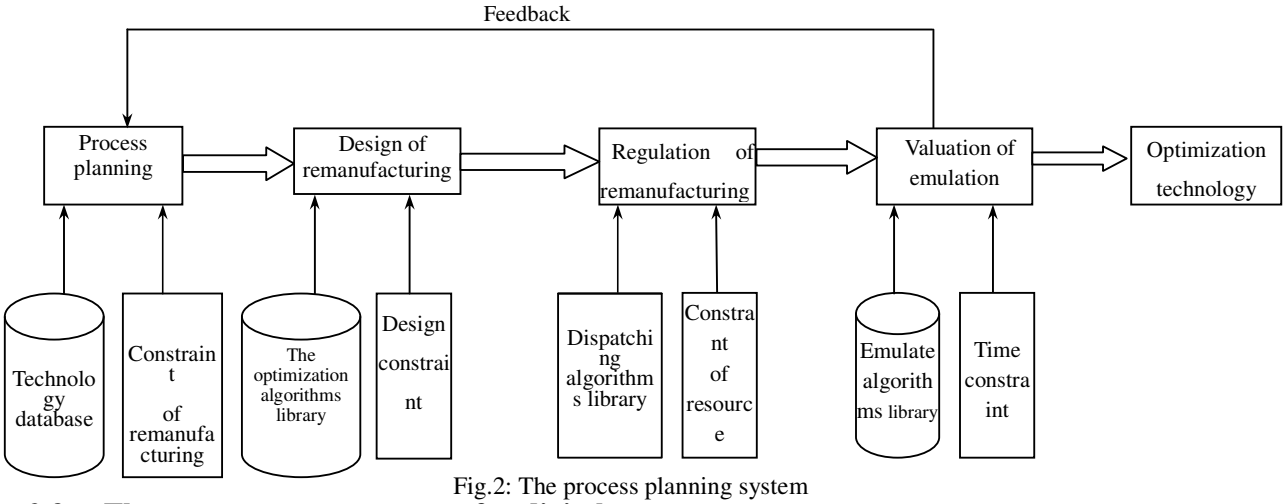

Fig.2: The process planning system

2.3 The process process of digital remanufacturing engineering for vehicle engine

Digital remanufacturing engineering for vehicle engine doesn't mean manufacture new vehicle engine or overhaul of vehicle engine in traditional sense, it is a new concept. It established the engine remanufacturing model with eM-Power, built the modernization virtual engine remanufacturing factory and the quick production line model and make arrangement for discrete event, according to the manufacturer standard of new engine to improve the model of remanufacturing quickly, implement simulation and optimization of engine parts remanufacturing. After the process of disassembly, clean, detection, remanufacturing machining, assembly and testing, the old engine has the same even exceed new engine in every index of quality and performance. The standard of engine digital remanufacturing process for old engine as the same as new engine. Fig.3 shows the technological process of engine digital remanufacturing.

The engine digital remanufacturing have the merit of high quality, high performance ,high efficiency and large batch ,the basic process of old engine digital remanufacturing line is : entry warehouse→disassembly→cleaning→detection and classificayion →remanufacturing process planning →process testing →remanufacturing → assembly →leaving-factory. Every process was simulated and planned by eM-Power. By the simulation and planning, the success rate of engine remanufacturing is great increased, the waste of resource is reduced, the information level of remanufacturing process is improved. The used functional modules include:

- eM-Machining main resolves the problem: the process planning of engine remanufacturing production line, choose the better processing policy, the better grind tools and clamp apparatus, NC simulation and production line balancing and so on . The program implement: a) the planning of production line b) the optimization of engineering and technology .
- eM-Assembly is a tool to dynamic analysis the assembly technology program and maintenance process. It can help we testing the feasibility of engine remanufacturing, and compare various system of assembly process and disassembly process.
- eM-RealNC main simulates to validate wheather the numeric control program is right or weather it can machining precisely.

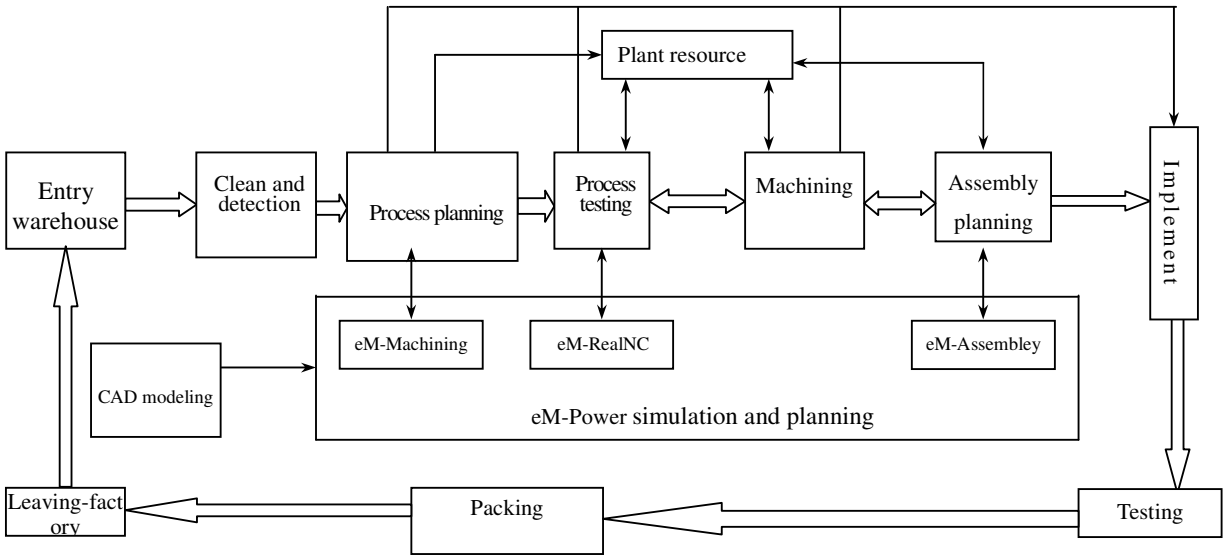

Fig.3: The technological process of engine digital remanufacturing

3 The process specification of digital remanufacturing engineering for vehicle engine crankshaft

Crankshaft is the most important and expensive part of engine, the life of crankshaft determines life of engine. When the engine are working, the surface of crankshaft bearing location will bear great compression force and very high break-away friction speed, the efficiency of bearing location elimination of heat is low, the surface of every bearing location grinding ahration easily. So crankshaft remanufacturing is an important part of engine remanufacturing. The technology program of remanufacturing production line will be analyzed in the fallow .Fig 4 shows the technology program model.

The process planning of crankshaft remanufacturing is based on trick recognition .The geometric models of old crankshaft and standard crankshaft were leaded in firstly. Through the compare of models, the character information and process character of crankshaft will be self-action recognitioned by digital factory, and choose processing method and design machining procedure automatically. The various courses in the followed picture are supported by crankshaft database, plant resource database and process knowledge database which includes the CAD model of crankshaft, processing knowledge, typical process regulation and the process resource of remanufacturing factory. The crankshaft has two failure modes including crack and abrade. Crack renovation usually by means of bead weld and impeller. The wear renovation process is determined by wear extent: brushing plating directly when the wear extent is little; spraying painting and grinding when the wear extent is big.

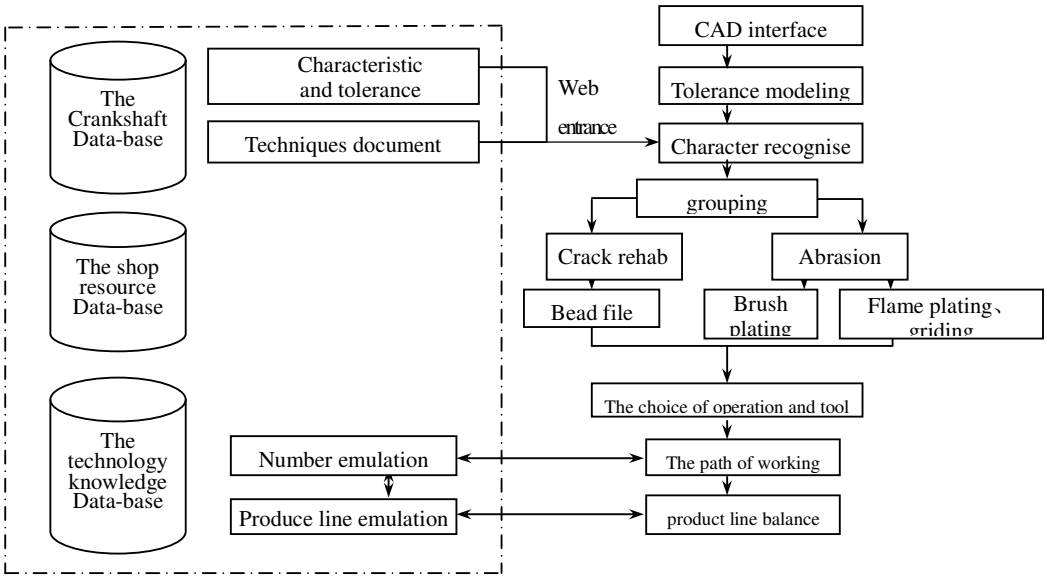

Fig 4:The process planning model

4 Conclusions

1) The architecture, process planning and technological process system of engine digital remanufacturing is established with the experience of mature digital manufacturing, and lay foundation for further studies on digital remanufacturing engineering of vehicle engine.

2) The process planning system of crankshaft digital remanufacturing which optimized remanufacturing process, reduced engineering risk, laid theory foundation for crankshaft digital remanufacturing.

3) Increasing the usage of plant resource, reducing the time of process planning and remanufacturing cost.

Acknowledgments

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