Chapter 6 Evaluation and Conclusion

6.0 Evaluation

The customisable production planning tool has been developed for the purpose of assisting production plants achieve competitive advantage through a well-designed, customised planning tool using object-oriented techniques and analysis. The customisable tool has been developed accordingly and the objectives have been met. Through this object-oriented method of development, production is well planned to satisfy customers' changing demands and at the same time controls the timing of the production activities besides giving flexibility to users in allowing customisation of their planning methods.

Initially the system's requirements were captured through the use cases which show what the customisable tool will do in the abstract level. While the use cases describe what the tool is supposed to do, the various object models describe how the customisable tool is architectured and designed to meet all requirements. The development of this tool is done through the iterative and incremental approach using the BCE types to show the interaction of objects of the various classes. The objects that perform the use case instances are presented in collaboration or sequence diagrams for each of the use cases. It then proceeds with the design model based on a layered architecture which saw the software taking shape with the development of the application systems which import from the component systems. The use cases were traced to the analysis model through to the design model which defined the implementation of the customisable production planning tool.

Users can customised their production environment by choosing from the three production environments. These production environments which can be set at any time of

the year following the production year is represented by three variability points in the **Adapt Plan Production Environment** use case. Other customised features include the calculation of inventory and forecasting methods which make use of variability mechanisms which are the extention points, that is actually a form of <<generalisation>> [Jacobson *et al.*, 1992; Griss, 1995d]. The customisation variants are denoted by extension points in the use case and object components. This variability mechanism provides a powerful way of making components more generic, thus enhancing reusability for future enhancement.

The implementation process of this customisable production planning tool used the top-down design of the application systems that are traced to the component systems, which in short is implementing the architecture as a layered system. A layered system is seen as a system of interoperating systems that incorporates five object models which are the requirements model, the analysis model, the design model, the implementation model and the test model. A layered system produces significant levels of software reuse in the architecture and design of the software systems. Besides, this led to a smoother implementation process and testing which ultimately produces a better and more maintainable system. Through object-orientation, systems are designed in a more modular and extensible way enabling them to evolve more readily as user requirements changes. This is important especially so for manufacturing companies which are subjected to constantly reduced lead time and product cycles coupled with fierce competition from outside, changes have to be made more readily and quickly. Thus object-orientation is the answer to these problems since the application and component systems can quickly be reused when adding enhancements in the near future.

In short, customisation allows users to customise their requirements thus adding flexibility to the use of this customisable production planning tool and wider reuse based on a layered system makes the latter a better choice for the manufacturing domain. This will enable manufacturing companies plan their production operations to suit the requirements of their customers as well as help them to achieve greater productivity and ultimately profitability. Although the objectives have been met, the following section evaluates the strengths and limitations of the customisable tool and seek to improve the quality of the overall system and how to add on future enhancements.

6.1 Strength of Research

Customisation of planning methods such as the production environments allow flexibility to end users to decide which one to use at any production period. Besides, this production period can be set at any time of the calendar year. Users can also customised their calculation of inventory and forcasting methods by setting their own fields and functions and the system will capture those variables and calculate them accordingly. These enable flexibility for the users in computing inventory and forecast since different production plants use different way of computation.

Object-orientation provides a consistent approach which maps clearly into a physical design and implementation through the use of use cases which model the real-world domain. The incremental and iterative approach to software development reduces risks by promoting evaluation and re-evaluation from analysis to implementation in a short cycle enabling the product requirements to evolve along with the software product under development.

Reuse of classes through component systems will allow future reuse in the development of application systems since the latter imports from the component systems. This will bring about reduced future development costs for later enhancements besides increasing extensibility. This helps reduce development time, enables systems to adapt more readily to changing requirements and reduces maintenance costs.

6.2 Limitations

The system uses the relational database with SQL instead of an object-oriented database with Object Query Language (OQL). This limits potential benefits such as better performance as OQL will automatically create their own objects and classes. However, SQL statements must be written precisely for each and every object in the source code. Any changes made to the requirements will mean having to rewrite those statements again but object-oriented database allows changes to be made direct through the OQL queries. Thus there is more flexibility and less time consuming coding using OQL.

Customisation features are limited to what have been allowed for the users. The customised features do not allow users to add more objects and classes into the database as they so choose.

Application systems are limited to just production planning which is from the time orders' are taken until scheduling starts, which is the scope of the software functionality. This does not include other modules of the manufacturing system such as material resource planning and quality assurance.

6.3 Future Enhancements

The customisable production planning tool developed from the application systems is an independent system. A future enhancement can include a client server system which is applicable for a large-scale industrial use. Besides, it should also allow end users to create, design and add more objects and classes into the customisable planning tool thereby increasing customisation that can cater to a wider spectrum of application systems meant for manufacturing use.

The planning tool can further be improved by adopting a fully object-oriented database for better management and improved performance. Although the full potential of an object-oriented database has yet to be realised, migrating to object-oriented database is seen to have better performance than relational database especially with the implementation of Object Query Language (OQL).

Another improvement in the future can also include making the customisable tool to be more reusable through framework development which allows greater levels of reuse as well more flexibility in terms of scalability. This can include an integrated family of applications which consist of all the manufacturing components found in the manufacturing domain.

6.4 Concluding Remarks

This research prototype is a step towards the improvement of existing production planning systems which still need further improvements, based on the research done as explained in the beginning of this dissertation. Since most production planning systems are not fully integrated as well as not designed to work together in the manufacturing domain, an object-oriented customisable production planning tool which is based on a layered architecture that is composed of application and component systems, will be able to achieve this purpose. In addition, object-orientation makes the planning tool more manageable and maintainable. The customisable production planning tool has been developed for this purpose of assisting production plants achieve competitive advantage through a well designed system with customisation using object-oriented techniques and analysis. The customisable production planning tool has been developed accordingly and the objectives have been met. A robust and scalable architecture enables software to be reused through the component-based software engineering process within the production application systems. Customisation allows more flexibility to the user in planning production activities. It enhances users' ability to adapt to their requirements more easily thus enabling them to use the customisable planning tool with ease. Besides, a use case model can be used to represent a high-level analysis model which captures system's requirements at an early stage in the development process. This analysis model gives shape to the system's architecture that brings about dramatic improvements on development time and costs. In addition, object-oriented development allows the reuse of components in future software enhancements that can accommodate the dynamics of a fast changing manufacturing environment. This will ultimately lead to a more efficient production

planning tool that will enable the manufacturing domain to gain advantage in the production of goods that will be able to meet customers' expectations and timing as well as their ever changing demand patterns apart from achieving a satisfactory level of profitability so as to prolong business life.