PDF-XChange Editor
Click to BUY NOW!
www.tracker-software.com

Buy Vs. Build

Part 1: Advantages of a Modular Design

By Wolfgang-Heinz Fischer, TQ Group

Embedded modules, sometimes referred to as Computer-on-Modules (COMs), or System-on-Modules, (SOMs), are the building blocks of the embedded world.

Using modules alleviates many of the challenges facing engineers and project managers when designing complex applications. Some of the obstacles and costs associated with designing complex computing platforms--certification, design and development time and production costs--can be overcome by using an off-the-shelf embedded module.

The following article examines some of these challenges and details how and where savings can be realized by opting for buying a pre-tested module instead of building a system from the ground up.

About the Author:
Wolfgang Heinz-Fischer is the Head of Marketing and PR for TQ Group. He is also a prolific author and speaker on modules and standards for the embedded industry.

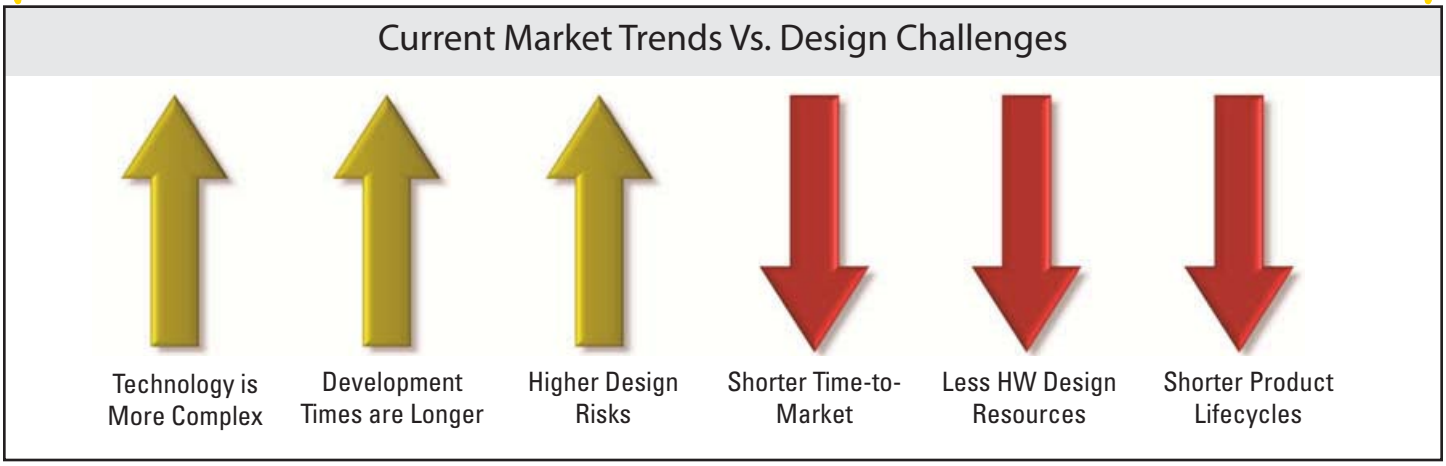
Saving money, minimizing risks and bringing a product to market faster are often at odds with reality. Technology is becoming more complex. It requires longer development times, and therefore more development resources, greater design risks and higher development costs. At the same time, however, development resources are being reduced or more and more employees are shifted to the software sector.

The software part of a product makes up an ever growing share and often actually represents the core competency of the user or of the application. This situation is compounded by the fact that a product's 10 to 15 year life cycle has decreased to 5 to 8 years today, which means more products have to be developed or revised in a shorter period of time.

> "Saving money, minimizing risks and bringing a product to market faster are often at odds with reality"

In addition, it is becoming increasingly important to bring a product to market in a timely manner which, in reality, can only be achieved by using a modular design. The community of x86 users has relied almost exclusively on modules or standard boards for many years; integration is the absolute exception here.

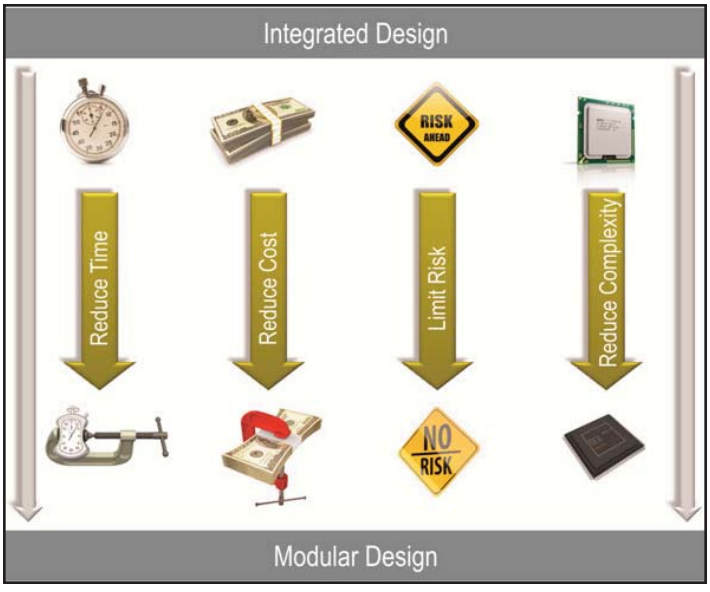
PDF-XChange Editor Click to BUY NOW! www.tracker-software.com



Selecting Modular over Integrated Designs

The concern that a modular design is more expensive than an integrated design is usually unfounded or based on an incorrect understanding of modular design. When can a modular design be recommended, or when is it the only way to develop a product?

Whenever in-house technical expertise or bandwidth is a reality (especially in the case of highly complex designs) , the modular approach might be the easiest and most economical way to solve this problem--apart from outsourcing the project entirely. A modular design can also help deliver the product on-time even with resource bottlenecks.



Pictured above: The differences between an integrated and a modular design, showing the distinct advantages of the latter.

Hardware and Software Time Savings Add Up

A look at the individual steps in the design process quickly shows where a modular design is advantageous. The time saved using a modular design is of course essential - after all, the processor module is already completed and has already been tested and, as a result, a crucial component of the hardware design is already available before starting the project. This makes it easier to design the application board and it can accordingly be developed more quickly.

> "Key software drivers are delivered with the module and can be used immediately--so software development can start on day one"

Some parts of the circuit can be deduced from the reference design in the starter kit, which allows the application board to be designed even more quickly and reliably.

Time can be saved on the software side as well. The key software drivers are delivered with the module already and can be used immediately--so software development can start on day one since the target platform is already available. Therefore, real parallel engineering can take place. Performance tests are often necessary before a final design decision is made. This, too, can usually be conducted with modules, further reducing development time.

PDF-XChange Editor
Click to BUY NOW!
www.tracker-software.com

Saving Money in Circuit Board Design

As a rule, the circuit board is another significant cost factor. In this respect, it should be taken into account that the circuit board configuration is always determined by the most complex switching element or structural element. For example, a Freescale® QorIQ™ processor with a speed of 1.2 GHz and a DDR3 memory requires a multilayer structure with microvia and at least 10 or 12 layers. In a modular design, the application or carrier board can usually be implemented more easily with 2 to 4 layers less due to a lower level of complexity.

Assessing the costs of the additional plug in a modular design compared to an integrated design from this aspect alone, one can quickly calculate that costs can be reduced here as well, or that no additional material expenses are incurred.

Circuit Board Math

The average price for a circuit board measuring 6.9 inches x 4.7 inches (175 mm x 120 mm) with 12 layers is about $30 for medium quantities. Using a module allows the multilayer structure to be reduced to eight or less layers. The circuit board price for eight layers is about $21 to $23 for the same quantities.

A set of mating connectors for a TQ module with QorIQ processor is about $7 to $9 per unit; consequently, no additional material expenses are incurred by using a module. A less complex application board certainly presents a lower risk for a necessary redesign than a highly complex board. This creates not only additional costs but also a time delay--which can incur more costs.

In terms of long-term availability, storage devices are the most critical components in a processor application today. For a product, this means that redesign will probably become necessary in the course of the life cycle due to discontinued memory modules. If modules are used, this is the responsibility of the module producer, hence further cost savings in the entire life cycle of a product.

Interest on Investments

If overall development costs decrease, the interest paid on these investments will be accordingly lower as well. If one expects to achieve cost savings of up to $135,000 in development, an interest rate as low as five percent means additional costs of $6,750 per year. Since the module will be used by many customers, each customer will benefit from the excess quantity produced by the module provider. And using a module in other products, that is, at higher quantities, results in additional room to negotiate a price. In addition to pure development costs, continued investments for the acquisition of the appropriate tools for development, manufacture and test equipment may be required.

Risk Minimization

Another crucial factor affecting developments today is risk minimization. Risk means time and costs. Since the design for the application board is much simpler in a modular design, the risk of eventual redesign is significantly lower.

> "In terms of long-term availability, storage devices are the most critical components in a processor application today. For a product, this means that redesign will probably become necessary in the course of the life cycle due to discontinued memory modules"

A redesign in the course of the life cycle usually becomes necessary for the embedded module only because this is where the memory modules are located. Less risk and timely completion of development can play a crucial role in contributing to a product's commercial success. What this means in terms of dollars differs from one firm to another and from one market to another. In addition, the low complexity of the application board allows many developers to realize more and more ambitious designs--one more reason to use a modular design.

A Design Calculator

By choosing an example with concrete figures and closely examining the individual steps from idea to end-of-life of a product, you can determine the advantages of a modular design or discover up to what quantity modular design is an advantage in a given case. The example presented on these pages uses a Freescale i.MX6 processor for comparison.

The Concept Phase

In the concept phase, analysis of the components to be used, determination of long-term availability, DfX (Design for X) concept, feasibility studies, and time and personnel requirements come to approximately $70,000 for an average design with an i.MX6 processor. With a modular design – the design of an application board – $27,000 is generally enough to budget for the concept phase.

Preparing a Circuit Diagram

Preparing a circuit diagram for an application board costs about $6,500 , especially if you can draw on existing tested circuit plans from the starter kit. When the processor is integrated, the circuit diagram becomes considerably more complex and usually costs approximately $25,000 to $30,000.

The Layout

The differences are even more obvious when it comes to the layout. Since the application board is clearly simpler to put together with a modular design, $13,500 to $15,000 will usually suffice. With integration, however, costs can easily double.

Prototype Creation

For creation of prototypes, the values for modular and integrated designs are usually not very different. However, differences can be considerable here if new equipment needs to be procured.

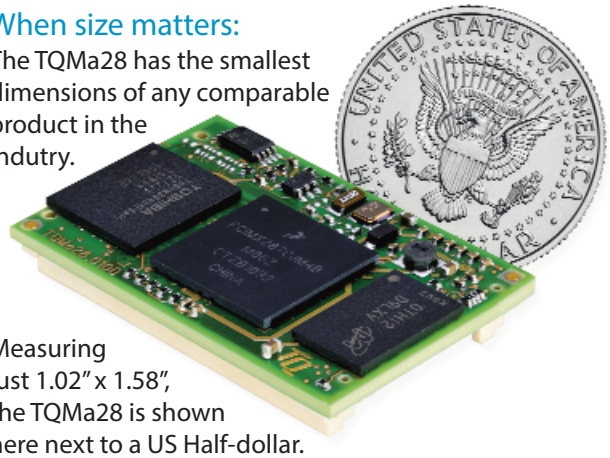
Paying for Drivers in an Integrated Design

The module is delivered by the manufacturer with certain drivers and BSPs included. If the drivers for an integrated design need to be created for the design itself, add a price tag of at least $50,000.

A TQMa28 module with a Freescale i.MX28 can save you design time and money.

When size matters:

The TQMa28 has the smallest dimensions of any comparable product in the indutry.



Measuring just 1.02" x 1.58", the TQMa28 is shown here next to a US Half-dollar.

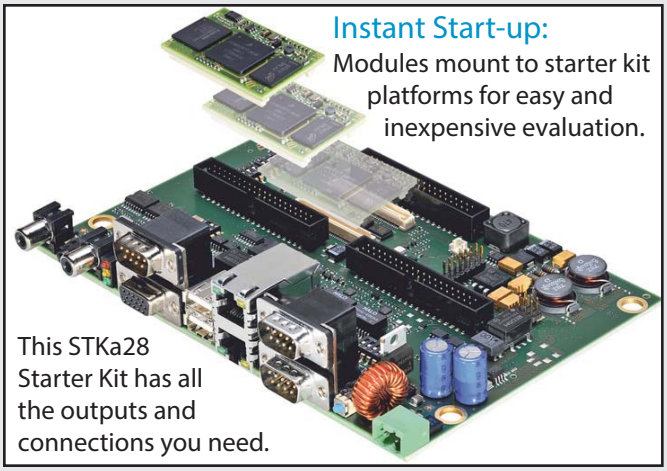
TQ embedded modules:

- Are the smallest in the industry, without compromising quality and reliability
- Bring out the processor signals to the Tyco connectors
- Can reduce development time by as much as 12 months

The TQMa28 module comes with a Freescale i.MX28x (ARM926™) and supports Linux, WinCE 6.0 and QNX OSs. The full-function STKa28-AA StarterKit is an easy and inexpensive platform to test and evaluate the module.

Instant Start-up:

Modules mount to starter kit platforms for easy and inexpensive evaluation.



This STKa28 Starter Kit has all the outputs and connections you need.

Buy the STKa28 Starter Kit today for under $650, and evaluate the TQMa28 Module for your next application at www.embeddedmodules.net

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

Controlling BOM Costs

BOM costs are reduced by the costs of the parts in the module and a more affordable circuit board, but are increased by the costs of additional connectors.

> "Additional costs of total development and product qualification can quickly run up to $250,000 to $300,000 for an integrated design."

Testing and Testing Equipment

The production costs themselves do not differ very much, but the case is very different for testing costs. As a rule, integrated designs require more complex testing equipment, and costs amount to $60,000.

Providing for Continued Product Availability

One of the leading factors in deciding to go with an integrated design or a module is the question--if you go with an integrated design, will your components still be available ten years from now?

Certification

What is it going to take to get certification for a medical (DIN EN ISO 13485) or aviation (EN ISO 9001)? Buying a module that is already certified will save a lot of time and money in the development process.

The Bottom Line

The examples in this article demonstrate that additional costs of development and product qualification can quickly become $250,000 to $300,000 for an integrated design--not counting the costs of additional risks of re-designs in the course of the product lifecycle, varying quantities for product planning, and interest charges. The break-even point after which an integrated version appears to become more affordable can be calculated very quickly. Once you've decided that going with a module instead of an integrated design is the right approach, then you can begin searching for the right supplier and the modules to meet your needs. *Good Luck.*

TQ-USA: Your Source for Embedded Computer Modules

TQ-USA is the brand for an embedded module product line represented in North America by Convergence Promotions LLC for TQ-Systems GmbH.

A global leader in electronic technology

One of the leading solution providers of innovative technologies for 20 years, TQ-Systems GmbH has their corporate headquarters in Seefeld, Germany, and employs over 1,200 staff and has production facilties in Germany, Switzerland and China. From their sales distribution and technical support network in Europe and North America, TQ-USA can guarantee customers quick response times through sales and technical support.

Certifications and Quality Assurance

TQ stands for Technology in Quality and their strict adherance to standards are exemplified by these certifications:
Quality Management: DIN EN ISO 9001: 2008
Medical: DIN EN ISO 13485: 2012
Aviation: EN ISO 9001: 2009
Automotive: ISO/TS 16949: 2009
Environmental Management: DIN EN ISO 14001: 2004

TQ modules are used in diverse applications

Our modules cover a diverse array of applications including applications such as ticket printers for public transportation, central fire alarm systems, aircraft cabin controls for major airlines, fork-lifts, photovoltaic systems, marine engine controls,medical devices, etc.

End-of-Life and Obsolescence Management

The Obsolescence Management Strategy developed by TQSystems protects your products from obsolete components, expensive redesigns, unsafe sources and costly brokerware. A permanent member of the industrial association COG (Component Obsolescence Group) Germany, TQ-Systems can assure their customers of continued service and a long-term supply of electronic components and modules.