FPGA Product Support and EOL as Past Performance Indicators

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Military acquisitions policy utilizes Past Performance Assessments as a risk factor when committing significant taxpayer dollars towards a military weapon system development. This is to provide incentives to defense contractors to optimize contract performance on current projects by impacting their future business, and also to vet younger, newer businesses against their more experienced counterparts. With a number of recent high profile obsolescence events among component providers, including processors and FPGAs, Past Performance Assessments of these component providers may be warranted in both controlling unscheduled defense expenditures, as well as providing incentives to system developers to reduce the Government's risk profile in component selection.

Introduction

Military communication and weapons systems are now overwhelmingly composed of high density, modern electronic components. Developing an *edge*, or competitive advantage, in the military marketplace necessarily requires taking advantage of the latest technologies, fastest processing, and the highest integration of analog and digital processes to reduce detection and response times in intelligence systems and military equipment.

These same systems, however, are often brought into service and maintained over time periods that are many multiples, or even orders of magnitude, longer than the constituent components of these systems. This inevitably creates the problem of component obsolescence, which is a primary issue in the field of logistics, and fuels entire industries of component and product emulation, reverse engineering, and code transfer and qualification.

In modern military systems development, obsolescence strategies are a part of doing business—both for ensuring the lifecycle requirements of the device, and mitigating the cost risk associated with obsolescence events.

FPGAs are a primary technology in dealing with obsolescence events in their ability to be programmed and emulate functions of obsolete digital and sometimes discrete electronics. However, eventually even the FPGAs themselves become obsolete and incur additional redesigns and re-qualification of military equipment.

This paper is designed to examine a short history of FPGA obsolescence, what factors are involved in an obsolescence decision on the part of FPGA vendors, and how FPGA users can use this knowledge to craft Obsolescence Risk Mitigation plans. It also introduces the idea of exercising Past Performance Assessments of FPGA vendors as both a risk and cost factor in making FPGA selection decision in military system design.

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Some Cost Data on Device Obsolescence

Supply chain services provider IHS estimates that overall end-of-life (EOL) and Product Discontinuation Notices (PDNs), as a percentage of system's bills of material, have seen a compound annual growth rate of 40% between 1997 and 2011.

There have been several events in 2013 that provide data for some of the cost impacts of unscheduled or unplanned obsolescence events. One military application impacting Army Communication-Electronics Command (CECOM), using FPGAs to process infrared images, spent between $1.4 and $2.6 million on a Last Time Buy (LTB) where the cost had to be transferred from elsewhere in the program. The same product EOL announcement generated several other LTB notices on Federal Business Opportunities website, including Army and Navy customers. These LTBs were all dwarfed by a single unscheduled expense of the Air Force's Joint Strike Fighter program, which spent $105 Million on over 80,000 FPGAs that were discontinued by their manufacturer. These numbers consider only a subset of the costs of a single product obsolescence event, and should be enough to attract the attention of taxpayers and defense acquisition officials.

EOL Mitigation Strategies and Planning

According to Military Embedded Systems:

> *"…it is common practice for Diminishing Manufacturing Sources and Material Shortages (DMSMS) and logistics teams to target obsolescence reactively, leaving critical systems vulnerable to LTB and EOL events."*

Obsolescence costs, especially for unscheduled product discontinuation or vendor dissolution due to bankruptcy or acquisition, cannot be avoided completely. However dual-sourcing and a few other strategies identified below have many precedents and examples of both success and failure.

Vendor Support Commitments

Signing a contract with a minimum support period is a common, but often costly, approach to ensuring a minimum time period and quantity of components for a program. Component vendors often only consider such commitments when a certain volume of business is guaranteed, or at a price premium to cover their risk in continuing the support of devices with rising support costs. For very high assurance systems, this can include a Federal Acquisition Regulation (FAR)-directed DX rating if procured directly from the Government.

Such support commitments naturally do not mitigate risks that impact business factors out of the vendor's control, such as supplier obsolescence market shifts that substantially threaten the vendor's business model.

LTB and Inventory Banking

It is the practice of most vendors to provide significant notification in advance of a product's obsolescence, and provide the opportunity for final order or LTB. This typically represents an unscheduled expense for the Government, to include component costs, storage costs, and little pricing leverage or contingency. According to the same previously referenced article in Military Embedded Systems:

> *"A LTB brings a false sense of security, and doesn't account for the follow-on sales or the logistics challenges of stocking and storing parts for the length of a program."*

By some second-hand estimates provided by Altera's military customers, the additional storage and inventory costs of these LTBs can add up to 40% of the FPGA material expense. This strategy also assumes a high level of knowledge or nearly perfect forecast of the supportable lifetime of a defense system, which has historically extended far beyond the original architectural level planning for many systems.

Rapid Modern Design Retargeting

Among the technical solutions or mitigations available are new proposed tools for FPGA design capture and retargeting to newer, supportable FPGA devices. This can be a feasible solution for programmable logic devices, though it still carries the burden of potential board redesign if there are no semiconductor footprint-compatible replacements, as well as potential system retest or requalification. However, the benefit of these proposed tool sets are that they have the additive additional benefit of insulating a high assurance design from the threat of gray market and counterfeit devices.

Selecting the Lowest Risk Vendor

Arguably, this strategy is not used widely enough in defense acquisitions. Traditional supplier profiles and past performance do look at a vendor's history, financial stability, and risk of the supplier as an on-going concern. However, these profiles don't necessarily look at the business structure, decisions, and factors that lead to product support and supportability decisions of their components in the long term.

Why Do Vendors Make EOL Decisions?

Articles have been published for years on the occurrence of obsolescence events and how to manage their risks, but few have examined the real decision factors that go into a vendor's decision to obsolete a product. It is assumed to be a *business decision*, driven by demand and aggregated product business, and the general market requirement for technology companies to advance to the next technology.

However, there several factors that lead to obsolescence decisions relating to semiconductor manufacturing. Among these are markets addressed by a product, the obsolescence of components or processes that are themselves elements of the component (including packaging, substrates, testers, and machining). But one that is rarely addressed openly in such discussions is economic benefit: it may be in the financial interests of the company to issue an obsolescence notice or order to generate last time buys to pull future revenue forward into the current year.

As the following decision factors demonstrate, not every FPGA vendor may have the same market and supplier factors that go into obsolescence decisions.

Focus: Markets Addressed

It was twenty years ago that the U.S. Department of Defense began strongly mandating the use of commercially sourced electronics to control costs. One of the primary reasons for these mandates is to aggregate Department of Defense demand as much as possible behind commercial devices in order to reduce their cost, as well as the potential longevity of these devices.

FPGA vendors naturally benefit from an aggregation of markets by providing similar programmable products across different industries. This provides a simple axiom in risk reduction for developers of weapon systems: the more *standard* a component used in design, the less risk accrues to the program office in incurring unplanned obsolescence events and costs.

Focus: Supplier and Foundry Selection

In the semiconductor market, there are a number of primary suppliers that comprise the majority of the component cost, value, and technology for integrated circuits: fabrication source or foundry, packaging component or supplier, and major intellectual property (IP) provider or licensor.

For the foundry source, vendors divide into those who maintain their own foundries, and the vast majority who utilize foundry businesses to implement their designs. For companies that operate both design centers and foundries, the supplier risk is simply the risk that the vendor will stay in business as an on-going concern. For the majority, however, foundry selection is a major factor in product support decisions down the road.

The first risk factor for a silicon vendor (especially FPGA) is the financial viability of the source foundry. As explained in *The Breakthrough Advantage for FPGAs with Tri-Gate Technology White Paper*, the R&D expense of the lithography, patterning, and manufacturing at new process nodes is increasing exponentially, reducing the number of foundries financially able to progress. So the first risk consideration is whether an FPGA product is produced in a financially viable foundry.

The next risk factor is the diversity of foundry sources utilized by an FPGA vendor. Vendors are financially incentivized to examine all available technologies for the one that will best meet their customer requirements. Further, there may be some supply chain risk advantage in selecting multiple foundries in case of calamity, or for price advantage. However, when an FPGA provider uses a large number of different foundry vendors, this has a very real impact on the cost of supplier management and the decision to obsolete a product when only a limited share of revenue is dependent upon each foundry. By contrast, when a vendor limits their designs to a single or small set of foundry partners, there is a better ability to aggregate revenue streams by foundry supplier, and justify continued product support decisions. Similar economic risk factors are created by the process technology chosen within a foundry, as the process selected (for example, *high performance* vs. l*ow power*) will see greater longevity if there are many different fabless designers utilizing that process.

A similar situation exists for suppliers of packaging, substrates, and substantial IP blocks (like hard processor subsystems) used in the manufacture of an FPGA product. There are flexibility and agility advantages in utilizing multiple package suppliers and IP vendors, but it also becomes harder to justify product support when different elements of a product portfolio source from different suppliers. Falling below *minimum order* thresholds is a more likely occurrence, and overall FPGA product obsolescence numbers rise and average product life begins to fall.

Do Vendors Significantly Differ in EOL History?

If market demand, and diversity of supplier and foundry, were the only two factors used in making financial or strategic decisions about product support and discontinuation, then obsolescence factors could be monitored fairly accurately by acquisition personnel and risk managers.

However, another unfortunate factor needs to be added: obsolescence decisions for financial advantage. Knowing that customers have a small set of choices for obsolescence mitigation (essentially just support contracts or commitments and LTBs), a vendor may knowingly obsolete devices with the purpose of initiating a LTB, and pull future year revenue streams into the current fiscal cycle. This can be done to boost current quarter revenue when a vendor is under pressure to meet revenue goals and estimates generated by the financial community.

As discussed earlier, there are real cost impacts to military and other customers from such product obsolescence decisions. The only real incentive for a vendor to avoid passing these costs on to customers is a Past Performance Assessment and Obsolescence Risk Assessments done at the time of component vendor selection.

Each of the major FPGA vendors used most widely in military systems has been in business and shipping components in excess of 25 years. With new product cycles every 2-3 years in conjunction with new silicon process technology, the list of programmable logic products and variants has grown quite large. In addition, this 25-year history of product shipments is now long enough to generate some data on the number of products or SKUs developed, how many of those products are still supported versus obsoleted, and what the average lifespan of a programmable logic device is likely to be given its addressed market, foundry source, and packaging supplier.

Competitive data on other vendors is not provided in this paper, but Altera provides the following recommended metrics and data to be used in a Past Performance Assessment. A complete data package to support the creation of these metrics for such an assessment can be downloaded by requesting access to the Altera® military portal on www.altera.com, or through your local Altera representative.

Some Metrics to Utilize in EOL Past Performance

One might mistakenly assume that an FPGA provider with the larger share of business in specific markets might have a better history of device support, based on an advantage in maintaining backlog. This assumption is not accurate – especially in the last few years. This white paper offers several alternative statistical metrics on which to evaluate an FPGA provider’s history of product support.

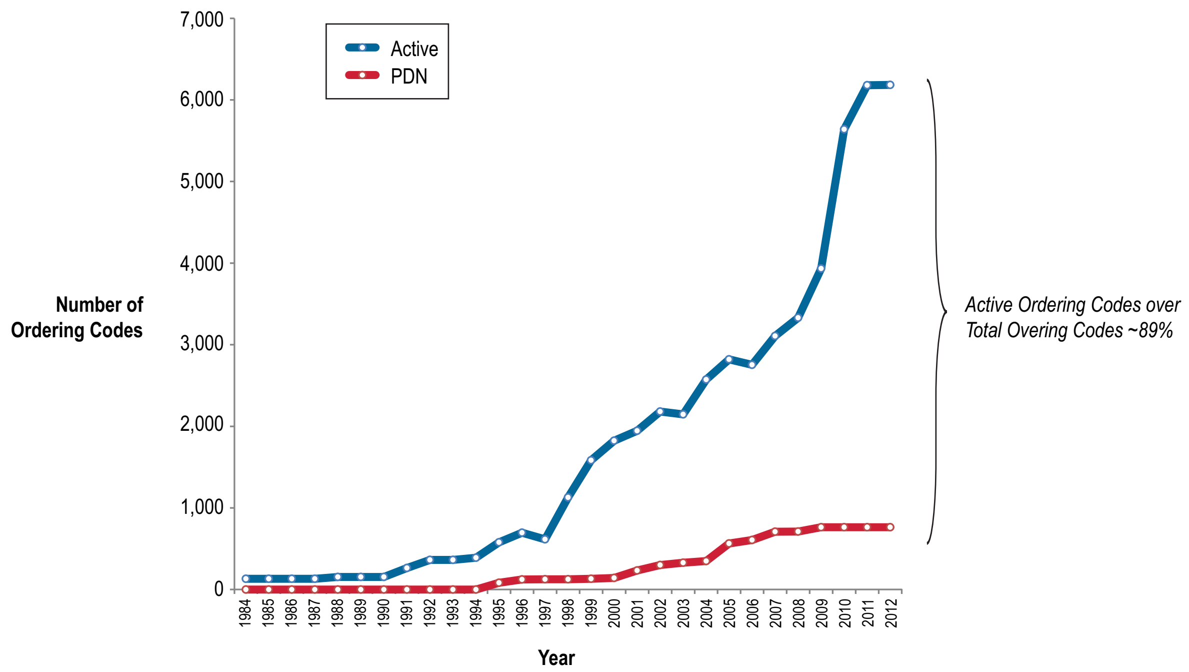
Based on 30 years of FPGA development and product support history, Altera offers the following recommended metrics in measuring the EOL Past Performance of FPGA vendors.

Percentage of Released Products Still Supported (by SKU Category)

Even with a limited number of CPLD and FPGA platforms being leveraged across many different market segments, FPGA companies generate a large number of stock keeping units (SKUs) and part numbers differentiated by size, speed grade, leaded packaging, temperature support, and so on. A recommended high-level metric of overall product support examines the entire history of part number generation, and determines the percentage of those products that are still available for order. It may be appropriate to remove outliers and non-applicable devices from consideration, either because they are specialized or custom devices, or are heavily impacted by external events like business acquisitions, divestitures, or calamities.

An example of such a metric is provided in Figure 1 for Altera devices over 30 years. In this example, ordering part numbers (OPNs) are grouped into classes and granularity is not shown for speed grade, leaded options, engineering sample devices, and so on.

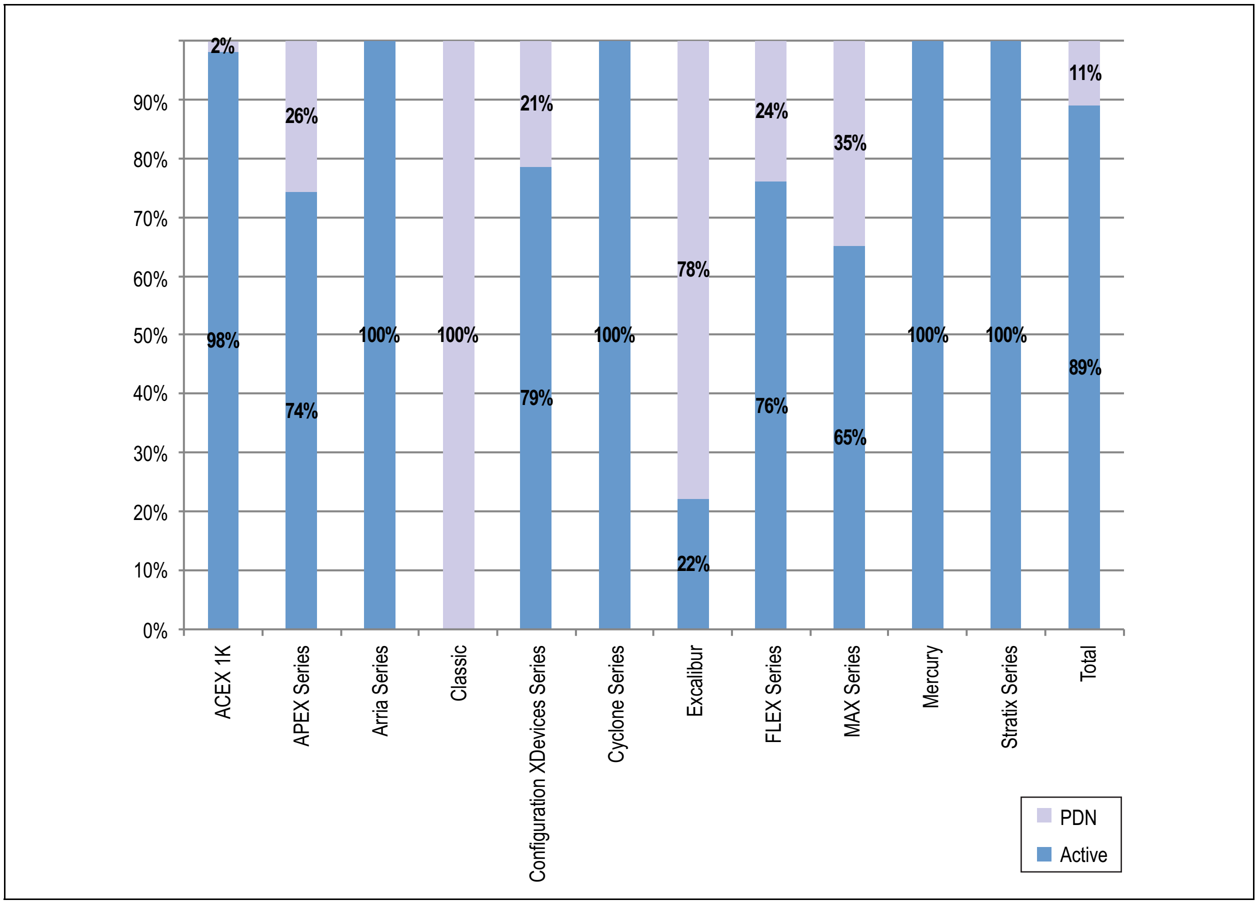
Figure 1. Example of Metric Showing Active vs. Discontinued Part Numbers



In this example, a metric is resolved showing that of 30 years of product releases, 89% of these products by part number are still being supported and can be ordered today. For an appropriate Past Performance metric, a military program office can limit this data to SKUs of interest from a data set provided on the Altera military portal.

An additional level of detail is shown in Figure 2 for these ordering codes, highlighting which product families saw the largest number of discontinued device ordering codes. The current generation of high-density, midrange, and low-cost FPGAs (Stratix®, Arria®, and Cyclone® FPGA series), and the Mercury family of products used extensively in military designs, all see 100% active ordering codes today.

Figure 2. Altera Active and Discontinued Product by Product Family

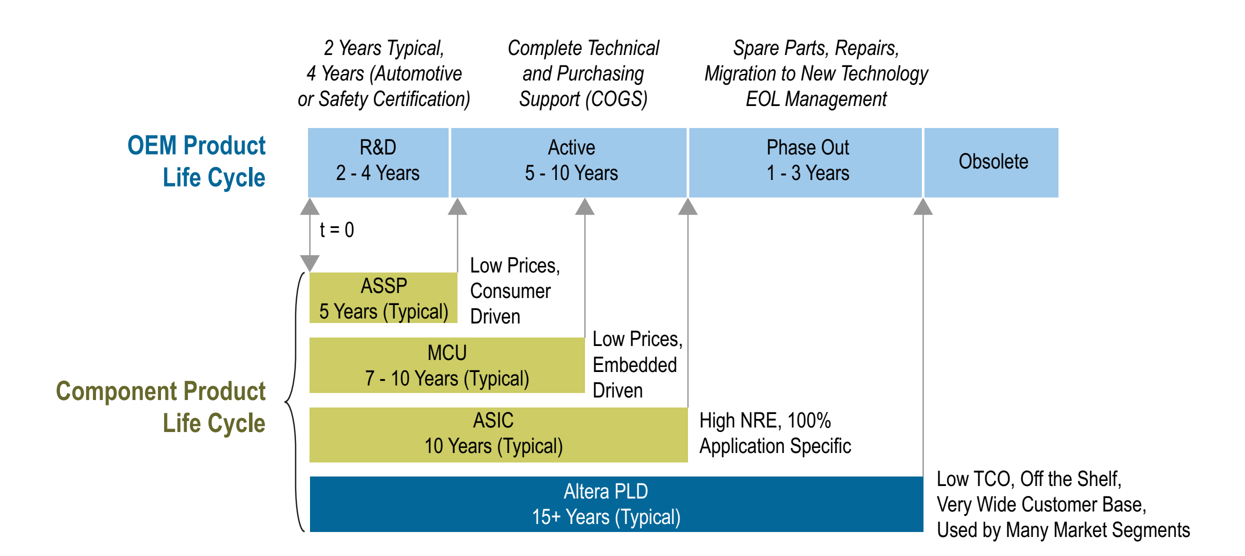


Mean Product Family Support Time (Silicon)

This is a key metric in assessing how to schedule technical refresh events, and potential LTBs, into a Life Cycle Cost model of both the FPGA component and the overall system. Assessing the expected lifetime of semiconductor devices based on actual history of product support show highly differentiated lengths of time between discrete components, ASICs, and programmable logic devices, and even some differentiation among different providers of programmable logic (see Figure 3). Altera does not have, nor does this paper provide, mean lifetime figures for non-Altera programmable logic devices.

Developing the appropriate mean lifetime support metric can be done with the same Altera product support data set mentioned in the previous section, selecting only similar products of interest for an appropriate Past Performance metric.

Figure 3. Mean Product Lifetime of Altera Programmable Logic Compared to Similar Components



Mean Product Family Support Time (Software)

Not only should a Past Performance Assessment look at the availability of devices for purchase; it is also important to look at the software support lifecycle for such parts.

There are a number of approaches one can take to developing this metric. However, the simplest one will be to look at the documentation for the development software for each programmable logic provider and determining how many previous product families are supported in the latest version. This can be done very simply from the device selection menus of Altera's Quartus® II, Xilinx's Vivado, and MicroSemi's Libero software suites. This may also be an appropriate metric to measure or assess using additional tools for system modeling, simulation, timing analysis, and synthesis provided by third parties.

How to Use These Metrics in Past Performance Evaluations

When performing a Past Performance Assessment of an FPGA or other silicon vendor on product support and obsolescence, it is probably not appropriate to utilize an entire data set (25+ years) of product data. It makes more sense to select from a more recent history of like products (for example, FPGA vs. CPLD or configuration devices). Selecting the metrics above, and an appropriate *like* data set, will maximize relevance.

In addition, there are several now-recorded instances of obsolescence or EOL events that have occurred in the last 10 years that have directly impacted military systems, and forced either unscheduled expenditures in life-time buys or redesign. Recording these instances, and estimating the likely cost and probability of occurrence of such events, will help assess obsolescence as a cost risk in total life cycle cost when selecting a silicon vendor. Several such events for the year 2013 are referenced in this paper, with annotations in the final section.

Conclusion

Past Performance Assessments have historically been used only for systems developers and integrators because of the complexity and impact of their role in the cost and schedule of systems. However, with the miniaturization, integration, and convergence of systems functions into components like modern FPGAs, cost and schedule risk are not limited to those primes.

Past performance of these component suppliers, FPGA and other silicon vendors, and their long-term product support, is the next logical step in extending Past Performance Assessments to further manage the life-cycle cost and schedule risk to military acquisition programs.

Further Information

- Altera EOL Data for Past Performance Assessments:
  www.altera.com/end-markets/military-aerospace/resources/mil-portal.html
- *Four Obsolescence Management Myths That Kill Defense Programs,* Military Embedded Systems, Ethan Plotkin and Kaye Porter, 10 September, 2013.
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- BOM Management Software Overview, HIS:
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- *Military to Buy as Many as 2800 Obsolete Xilinx FPGAs for Infrared Sensor Processing*, Military and Aerospace Electronics, 29 May, 2013.
  www.militaryaerospace.com/articles/2013/05/Xilinx-IR-processing.html
- *Xilinx Field Programmable Gate Array Proposed Last Time Buy,* Federal Business Opportunities, 23 April, 2013.
  www.fbo.gov/?s=opportunity&mode=form&id=7e9b410f49659c55e13564f3fcd20ce3
- *Field Programmable Gate Array [Last Time Buy]*, Federal Business Opportunities, 2 April, 2013.
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- *Lockheed Awarded $105 Million to Buy Parts from Xilinx*, Motley Fool, Rich Smith, 10 June 2013.
  www.fool.com/investing/general/2013/06/10/lockheed-awarded-105-million-to-buy-parts-from-xil.aspx
- *Counterfeit Mitigation by Rapid Modern Design Retargeting*, John Hallman Jr. and Brian Knight, MacAuley Brown Inc., 31 March 2014.
- *The Breakthrough Advantage for FPGAs with Tri-Gate Technology,* June 2013:
  www.altera.com/literature/wp/wp-01201-fpga-tri-gate-technology.pdf

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Document Revision History

Table 1 shows the revision history for this document.

Table 1. Document Revision History

Date	Version	Changes
March 2014	1.0	Initial release.