

Published: February 24, 2011
Find more content on:

Design for Regulatory Compliance

Designing products with a regulatory strategy in mind can eliminate surprises.

By: Bill Saltzstein

While working for Hewlett-Packard's medical group, a manager said, "When the barriers to entry are high, those who overcome them have a strategic advantage." That adage has remained important in the context of the ever-changing regulatory processes that are an integral part of bringing a new medical device to market.

There has been much debate and consternation, especially recently, about the 510(k) process, and there will undoubtedly be changes going forward. This article proposes a fundamental shift in the philosophy of how regulatory processes could interact with the product development process and paradigm to produce greater efficiency and more predictable results, regardless of how regulations evolve in the future.

As a product designer, it is often easier to criticize the process than to figure out how to make it work to your advantage. However, there are steps that can be taken during the product design phase to make the regulatory process more effective. Design for regulatory can become a strategic advantage. This article discusses what design for regulatory entails and what it would mean to incorporate regulatory thinking into the design process.

The Regulatory Challenge

What does design for regulatory mean? It is a process just like those currently in practice:

- Design for reliability.
- Design for manufacturability.
- Design for electromagnetic compatibility (EMC).
- Design for testability.

Each of these paradigms brings the domain expertise of what is considered a downstream product development activity into the early design process. The goal is to eliminate surprises late in the product development process that often produce negative effects such as expensive reworks, missed milestones, and ultimately delays in market introduction and sales.

So how do we start? The first thing to do is to google “design for regulatory.” You’ll find mostly bits of narrow work on EMC and wireless design, and the Web sites of several regulatory affairs consulting companies. There are very few online search hits on how to introduce regulatory concerns into product design and even less information about that process for medical product design.

Let’s start by understanding the goals of the regulatory processes. In general, they exist to ensure that safe and effective products are delivered into the market place with appropriate risk-benefit ratios. Every manufacturer, designer, regulatory professional, medical practitioner, and consumer has this as a common goal. However, if this is the case, why are there continually issues? The issues originate in the way regulatory compliance is treated during the development process. It is often seen as an afterthought or a necessary evil to be tested for and sometimes gamed at the end of the process when negative regulatory feedback is very frustrating and expensive. Even one request for additional information can be devastating to a company’s plans and financial well-being. Funding for start-ups and small companies is often tied to regulatory milestones.¹

Some companies take risks, purposely or not, by trying to do the minimum required or carefully crafting claims in the hope of getting past FDA. Although these strategies may sometimes work, clearly they do not lead to predictable success, because they can lead frustrate or anger reviewers. A perceived movement toward a more risk-averse FDA make this approach less likely to produce a successful outcome.

So what can you do? With existing ‘design for ...’ processes, teams consist of the stakeholders who ensure successful execution of the plans. Similarly, companies can incorporate regulatory affairs professionals (or those with extensive regulatory experience) directly into their design teams to ensure that the regulatory concerns and requirements are addressed in planning and subsequent design phases. This approach encourages the team members to use their experience and expertise to design products and test programs that will allow the creation of regulatory-ready products.

The team can also gather the data and analysis to support smooth submissions and hopefully clearance and approvals.

As with any good multistep reform process, the first step is to admit that there is a problem and agree that the organization wants to solve it. Although regulatory progress is difficult to track until a product is near the end of the development process, the resources to do so either already exist in organizations or can be identified and assigned (or contracted) responsibilities early in the project. Any costs involved are limited to the necessary regulatory resources. There are large savings to be gained from limiting redesign, additional tests, rounds of regulatory review, and delayed sales.

Intended Use and Indications for Use

The most important product features to agree upon in the beginning of the development process are intended use and indications for use. Although the exact definition of these terms (other than what is provided in 21 CFR 801.4) is currently under discussion at FDA and will evolve, they essentially refer to what the device will do and how it will be used.

Companies often get to the end of product development and have heated internal discussions with designers, marketers, and regulatory groups, discovering that the features and claims made in submissions do not support the marketing materials. The process of making changes and realigning messaging is expensive and highly disruptive to an organization. Having a clear discussion and agreement, as well as forming a written documentation up front that including intended use, indications for use, and claims, will add consistency and predictability. The claims form the starting point for submission packages, provide requirements, and drive specifications in the product design. Verification and validation testing and collateral materials, such as user documentation and marketing materials, become well aligned with claims from the beginning of the process.

Standards and Guidance Documents

Industry standards should be used and referenced wherever it is appropriate. Standards can be a touchy subject in the competitive marketplace, but they are essential for evaluating and comparing performance. Groups such as AAMI have shown that standards can be effectively developed in an open and nonthreatening forum and include all parties concerned.

Standards allow agencies to efficiently evaluate conformance and hold each device to a minimum level of performance. Standards do not stifle innovation but instead channel it towards exceeding performance and reducing costs by concentrating company efforts. They also allow direct head-to-head comparisons in the marketplace between competitive products.

When a design team uses standards and guidance documents as design input, the documents should provide the minimum requirements. Exceeding the standards can have market advantages if doing so results in demonstrable benefits. For example, IEC 60601-1-11 requires an operating temperature range of 5°–40 °C for transit operable home healthcare medical equipment. However, there are many use environments use in which this specification could be exceeded—Fairbanks, AK has an average low temperature of -28 °C in January and Phoenix, AZ has an average high temperature of above 41 °C in July.

Designing and testing to a larger range can allow marketing claims of operation in less restrictive environments and could yield customer benefits or fewer service and device failure issues. These advantages must be supported with appropriate evidence as required by the regulatory process.

When there are multiple standards, such as foreign agency requirements, the regulatory and design functions need to work together to select the superset for the product specifications to allow smooth introduction into additional markets.

Guidance documents from regulatory agencies are not standards in the literal sense, but should be treated as standards and their recommendations incorporated as design input. Not taking guidance documents seriously or assuming that they are not applicable to a product is a common and unfortunate mistake. If a company elects not to follow an available guidance or uses only portions that it considers applicable, it should develop and support that justification decision early in the design process. In addition, everyone on the team should be comfortable with the decision, while the results of testing to support the decision should be incorporated into the early regulatory submission drafts.

Don't forget to review draft guidances and search for prepublication drafts that may provide insight into changing agency expectations. Although these drafts may still be open for comments or not yet finalized, they can provide valuable insight into FDA's current thinking in a particular area. The agency has been known to enforce draft recommendations. Paying attention to these expectations early on saves time and labor later in the process since drafts early in a product development cycle often become defacto standards or are incorporated into standards by the time the product is ready for submission.

Have a Regulatory Strategy

Once the device use and standards are understood, it is time to work on the regulatory strategy. Early in the design process, discuss and include the following key items:

- Proposed claims.
- Preliminary instructions for use.
- Predicate device choices. It is also wise to obtain the predicate device's 510(k) filings through Freedom of Information Act requests.
- Device classification—Class I, II, or III; exempt; 510(k); or do the claims point towards a PMA?
- Foreign marketing strategy and additional regulatory agency requirements: CE, Health Canada, Federal Communications Commission, Health Insurance Portability and Accountability Act of 1996.
- Packaging needs and labeling requirements, including international symbols and warnings.
- Comparison testing, including bench and clinical testing that is needed to support substantial equivalence.
- Test plan to show conformance to existing standards. Differences between predicates and standards, and how the differences (if any) will be represented and supported.
- 513(g) (request for medical device classification) or preinvestigational device exemption (IDE) meetings with FDA to help support the strategic regulatory path.

- Using off-the-shelf components or technology to ensure their safety and effectiveness with the device.
- Reimbursement strategy and requirements for supporting data—this may drive claims and substantially change the strategic product focus. While not the focus of this article, it is an important part of the business plan for any medical product or service. Create a parallel review process to make coverage determinations while FDA clearance or approval is under discussion.

These are extremely important discussions and decisions, and it is necessary that they be appropriately documented. The discussions and factors evaluated that ultimately drive the decisions are just as important to helping the decisions stick and keeping the project from disruptive reanalysis procedures.

The discussions may bring up substantive issues and create an opportunity to alter the design of the product to resolve regulatory issues. Designers should not panic or try to game the system. Most often, a company will lose with a strategy that tries to get around regulatory issues or obscure them.

Consider issues rationally. They may lead to changes that can be useful for the customer or create an opportunity to raise the bar with FDA. For example, the ability to collect additional device data during use can enable additional markets if properly specified and implemented. These types of features may also be used production testing and field service.

Comparison testing and data collection cannot be overemphasized. A company can create a submission that gives it an advantage over competitors by including excellent comparative data beyond that which was provided in past submissions. These same data can then be used for marketing purposes, making it difficult and expensive for competitors to respond once the product is introduced into the market and increasing the hurdles they'll face when submitting data for a future product.

Consider the pre-IDE meeting and present your design for regulatory compliance case to FDA. Helping the agency understand that the device is designed to be a proactive part of the regulatory process can help the company gain support from the group that will be reviewing the submission. The pre-IDE meeting is useful for identifying issues and establishing allies at FDA.

Prepare Submission Documents During Product Design

Once the input requirements and product specifications are complete, the design team will have much of the information that it needs to create regulatory submissions for all countries in the business plan. Although the test data are missing, the tables can be created proforma to be filled in with the appropriate passing verification and validation data as those tests are completed.

All too often, these documents are prepared much later in the process. It is easier and less expensive to make changes early in the process. Regulatory changes are no different, except that in the past, companies have rarely considered altering products to

facilitate easier and more complete regulatory approvals. Instead, they alter product claims and limit the market potential for their device. In the long run, this approach is more expensive.

Creating these documents early allows a company to identify and fix deficiencies relatively easily and at low cost. Early creation of these documents may also alter the regulatory strategy.

Hazard Analysis

Surprises in the regulatory process can often be traced back to hazard analysis. For the purposes of this article, the term hazard analysis is used as a broad category to include failure modes and effects analysis and all other appropriate risk and hazard analysis methods as appropriate to medical devices.

Issues usually arise from the omission of hazards associated with new technologies (such as replacing a cable using wireless technology) or unrealistic scoring of the hazard or its mitigation. Whether this results from a lack of appreciation for new hazards or unquestioning reuse of the analysis from the previous product generation, omitting them can result in huge issues.

This analysis gives another opportunity to design for regulatory as it provides additional input requirements. Product design changes potentially provide the strongest mitigations and are sometimes the least expensive. Design changes early in the process are much less costly and time-consuming than production tweaks. Features can be added to provide extra security or robustness to data, and additional features can aid in verification for other mitigation tasks that may not be present in the core product features and specifications.

Good guidance for hazard analysis is provided in ISO 14971, and it is often very helpful to carefully review the analysis of predicate devices.

Protecting and Patenting Features for Compliance

Pay particular attention to any features added to a product to facilitate the regulatory submission, such as those allowing for data collection during verification or validation testing, or those mitigating hazards. Review of these features and their implementation could find patentable material and once again, competitive advantages. Patents do not need to be flashy to be useful in making it difficult for a competitor to execute its regulatory strategy. Consider any feature that has been added as a result of the regulatory review or a unique design element that allows easier demonstration of safety or efficacy for protection.

Design the Test Program

Creating the regulatory plan and prototype submission early allows some creativity in combining elements to make the most efficient testing program. For example, during the setup testing phase for a new product, testing of predicate and competitive products can be performed with minimal extra work and cost. It is useful to know how the competition performs not only for the regulatory submission, but also for product marketing

purposes. If a key product performance result can be identified and supported in its value to the product or for the customer, FDA might recognize it as a requirement for future products submitted by competition.

Highly accelerated life testing and highly accelerated stress screening testing are excellent methods. However, do not underestimate the value of testing the boundaries during standard performance testing.

A test program will often adhere to the internal and advertised specifications to set test limits. This information is essential for submissions, but while a test is set up, it can be very useful to continue the testing to establish design margins and potentially useful characterization information. This information can help demonstrate the robustness of a design and might allow for an increased warranty to the customer or lower accrued warranty cost expectations.

Test failures are inevitable. Fixing issues that are identified during validation or verification activities provides another opportunity to consider the big picture and include regulatory considerations.

Although EMC has received attention from the agency (including establishment of a relationship with the FCC), don't forget that it is also an issue for the customer. EMC testing of competitive products can yield an understanding of potential interactions as well as their product weaknesses. It will allow design changes that make products more compatible and support the customer with useful installation and operation information. It could also potentially give sales and marketing departments useful competitive data.

Design Teams and FDA Submission

The designers have unique insight into the product and its technology. It is an advantage to use this knowledge in drafting particular sections of the submission, technology descriptions, and comparisons. Since the entire team has been involved in the process, everyone will be proactive and engaged. There will likely be sections of the submission that can be reused directly from product design documents, because they contain supporting material such as drawings.

Reviewers Are Your Friends

Finally, the reviewer is your friend; the design team should believe this statement too. Make it a primary goal to educate your reviewer(s). They have a huge workload that consists of many different products and may not have the depth of knowledge and expertise to fully appreciate your product. Think about helping a friend understand this great new product and you'll have a much better submission.

Education is even more important if this product introduces a new technology or technique. Don't assume that once it appears on Wikipedia your reviewer will be an expert. Once this is established as an operating principle, good things can happen. People will think about how to make the reviewer's job easier by providing excellent data and supporting material. Any new or complex concepts will be accompanied by

excellent industry and peer-reviewed reference material. Reviewer-friendly submissions will help you gain allies at FDA.

Conclusion

Design for regulatory is a valuable concept, regardless of future changes to agency requirements or processes. Other 'design for...' paradigms have shown that up-front, early consideration of tasks that are usually performed at the end of the product development process reduces time to market and costs associated with redesign. Although following the suggestions in this article is not without cost, doing so is a worthwhile investment. The development of a solid regulatory strategy and the incorporation of regulatory resources into the design process will ensure fewer surprises and allow for more efficient and potentially easier FDA submissions. This paradigm can also yield better competitive information and product positioning and potentially create a competitive advantage in the marketplace.

Reference

1. Conroy S, "Reduced VC Funds Means New Challenges for Medtech Start-Ups," MD+DI 32, no. 10 (2010): 18; available from Internet: <http://www.mddionline.com/article/reduced-vc-funds-means-new-challenges-...>

Bill Saltzstein is founder of Code Blue Communications Inc. (Woodinville, WA).

Published in [MD+DI](#), [March 2011](#), [Volume 33](#), [No. 3](#)