



The Solutions People

# Tech Debt Zero

PART1

## CLEARING YOUR **TEST AUTOMATION BACKLOG** WITHOUT STALLING FEATURE DELIVERY

## EXECUTIVE SUMMARY

The most common and corrosive form of software technical debt is **insufficient test automation**. A lack of appropriate automation slows down development, reduces quality, and increases R&D costs.

A manager who has a backlog of test automation work has three choices: let it continue to accumulate, redirect energy away from development of new features, or – ideally – find **additional engineering capacity** that does not take away from new development. Engineering capacity is readily on offer from contract engineering firms, but managers are often reluctant to engage such firms, for three reasons:

- 1) the **risk** of not getting a successful result,
- 2) the **effort required to manage** an additional team,
- 3) the **high cost** of onsite contractors vs. the low efficiency of remote teams.

**These three issues can be solved.**

This paper outlines how elnfochips clients are attacking their test automation challenges without stalling internal development efforts. It describes the best practices we and our clients follow to achieve a project success rate above 98%.

## TOPICS

- Understanding the problem
- Solving the remote team challenge with Amplified Offshoring
- Five more best practices in engaging an outside engineering firm
- Achieving leverage with pre-built frameworks and test cases
- Results: three brief case studies

## UNDERSTANDING THE PROBLEM

“More software faster” is the constant demand put on R&D teams.

If you're lucky enough to have inherited no technical debt, then going faster is a Simple Matter of Programming (ha!). Most software managers are not so lucky. Most of us are constrained by the compromise choices made in previous years and past releases. The tech debt baggage left to us by our predecessors limits how fast we can actually go.

Ah, if only full Continuous Integration could be achieved – how much faster everything would be! For those who didn't start there, though, it's a difficult goal to achieve. Your tests have to be fast enough that an appropriate subset can be run at each checkin, and the test suite has to be thorough enough to protect the tree, other developers, and ultimately your customers. Investing in this level of test automation pays huge dividends over time, but it can be difficult in the short term to prioritize this work over immediate customer demands.

“56% of enterprises lack effective testing procedures”

World Quality Report, 2015-16

Another challenge is availability of the right people to take on test automation tasks. Testers are skilled at operating the product, executing test plans, and logging defects; test engineers know how to create test plans and train testers; developers in Agile organizations are expected to code many of their own tests. These roles are important but generally not sufficient. Over the last decade, another crucial role has emerged: the Software Engineer in Test/Software Developer in Test. SEiT/SDiTs are responsible for building and maintaining a complete parallel software system whose purpose is automated validation of the company's actual product. A good SEiT needs hardcore software development skills combined with a test engineering mindset. Software Engineer in Test has become arguably the most difficult role to staff in modern software engineering organizations; as of this writing, LinkedIn shows more than 4,000 open SEiT/SDiT positions in the San Francisco Bay Area alone. What's a VP of engineering to do, when in addition to the usual reasons for tech debt accumulation, best intentions are foiled by “staffing debt?”

## SOLVING THE REMOTE-TEAM CHALLENGE WITH AMPLIFIED OFFSHORING

In an ideal world, outside SEiT resources could service a company's test automation backlog, leaving internal teams free to continue feature development. Engaging an outside team has its own challenges though. Many managers have experience with outsourcing projects that took way too much effort and delivered way too little results.

The greatest impediment to using any engineering services firm is the difficulty of managing remote development. Some clients, therefore, try to bring all contractors onsite. That approach can work in the short term, but over the long term, it can be both costly and culturally difficult to sustain.

eInfochips clients have enjoyed success with a model we call **Amplified Offshoring**. In the Amplified model, a small number of eInfochips engineers join the client's team at their location for the entire duration of the project. These onsite experts analyze requirements, contribute code and – most importantly – mediate communication and time-zone differences, to keep the remote team productive without burdening the client.

A typical engagement begins with all or most of the contract engineers onsite at the client's location. As the teams become well acquainted, the offshore part of the mix increases. We have found that once the project stabilizes, a remote team functions well with about 10% of its engineers at the customer site; a lower proportion reduces productivity while a higher proportion can be unnecessarily costly.

## ENGAGING AN OUTSIDE FIRM: FIVE MORE BEST PRACTICES

Industry conventional wisdom, confirmed by discussions we've had with clients, says that as many as 20% of outsourcing projects are outright failures. Yet we've been able to maintain a **success rate higher than 98%** for more than two decades. Along with the Amplified model described above, there are other things our clients are doing that contribute to that high success rate. Here we've distilled five of the most relevant lessons – four of which apply to any form of contract engineering, and one of which is specific to test automation.

- 1) Agree on measures of success.** The client and the contract firm should have a clear and aligned understanding of how project success will be measured. For test automation projects, metrics like Defect Removal Efficiency (DRE) and percentage of cases automated are often a good starting point. The mutual understanding should be reviewed quarterly – sometimes the client's goals change, and while the contract engineers "on the ground" redirect quickly to follow new instructions, it's important in that situation to revisit assumptions and dependencies.
- 2) Overinvest at the front end.** Once you have a relationship with a contract team, you'll find that it's less work than you expected. But for the first few weeks (or even a few months on large projects), it may be more work than you expected. At the beginning of an engagement, outline the areas that are most difficult for an outside team to understand (which often are the same areas that your own new hires take the most time to master), and sequence the work so that the contractor encounters some of these challenging areas early in the project. The goal is not to set the contract firm up for failure, but rather to encounter, and work through, the sort of bumps that will inevitably arise. What you want to do here is exercise and tune the "meta-process" of identifying and fixing misunderstandings.
- 3) Use Agile principles.** You may or may not use a formal Agile framework like Scrum. (If you do, some of its structure will need to be adapted to support a remote team – the onsite Amplifiers will help with that.) Whether you use Agile or not, it does offer certain universal principles that are crucial to project success; the most important of these, we've found, is the continuous improvement feedback loop achieved through some sort of regular retrospective.
- 4) Keep your expansion options open.** The effort to manage an outside R&D contractor doesn't scale linearly with the scope of the engagement – as the relationship gets larger, your management effort per unit of contract R&D will decline. For this reason, among others, successful relationships usually expand in scope – for example, from test automation, to bug fixing, to refactoring, and ultimately to new feature development. You may not have concrete plans to expand the relationship beyond the initial project, but choosing a firm that has adjacent skills leaves you the option to increase the scope later. (Even if you never expand the scope of the relationship, a firm that has experience with adjacent steps in the R&D pipeline will better understand handoffs to and from your in-house team.)
- 5) For a test automation project, make sure the firm assigns engineers with software development experience** – since what they'll be doing is building a software system to test your actual product. In some firms the strongest testers get "promoted" to become developers, leaving test engineering staff relatively more junior. But as mentioned earlier, the SEiT role is one of the hardest roles to recruit. The right approach, which is the opposite of that practiced by many firms, is to promote strong developers into SEiT work, since a great SEiT can make the entire development team more productive.

## LEVERAGING PRE-BUILT TEST CASES AND FRAMEWORKS

It's commonly believed that remote teams deliver lower output-per-engineer than in-house teams, which partly offsets their lower cost-per-engineer. In some cases, though, a contract team can deliver significantly higher output-per-engineer than in-house resources, because the contract firm has already developed reusable test software to address similar test problems for other clients.

Products in the same category tend to have a higher overlap of features, even if the under-the-cover implementations differ dramatically. e-Commerce systems, for example, generally all include the same customer journey steps: discovery (search/browse/recommend), selection (product/variant/component, upsell), identification (login, account creation), payment (promotion, stored/new payment), fulfillment (shipping, tracking). Within a services-company model, a mostly-reusable test library can be used as a starting point, then customized for each client, at a significant savings compared to developing a test suite from scratch. In the commerce space, for example, eInfochips starts with a library of more than 500 automated tests covering the common customer journey. We have similar libraries for video conferencing, video surveillance, IoT, and other application categories as well, with new ones under development all the time.

Another opportunity for leverage lies in test framework development and customization – including libraries of common functions like social-networking authentication and sharing; multi-target support (web/Android/iOS testing driven from a common test description); and automation of test execution and measurement. Here, there are commercial and open-source products available, and some of our clients have had good success with such systems. Others have found that the cost, complexity and customization requirements make off-the-shelf products more trouble than what they're worth, and in those engagements we have supplied our own test framework, AQuA Testborg™. The AQuA framework is designed to be customized per-client; it supports the most commonly used functions of off-the-shelf test frameworks, with superior multi-target support to drive web and mobile test execution off of common definition files. Here again, clients may find that a specialist test-automation practice with reusable code available can save effort compared to in-house development.

## RESULTS: THREE BRIEF CASE STUDIES

### PROJECT 1: ECOMMERCE × (WEB + MOBILE) × MULTINATIONAL

A US-based nutrition products retailer with significant international business engaged eInfochips to create a comprehensive test automation system.

The client has separate web sites and native apps per country, resulting in a complex test matrix covering multiple browsers and multiple native apps, across different devices and screen sizes, across multiple languages, and including integration with a half-dozen social networking platforms. In addition to automating test cases, it was important to capture the commonality across the test matrix, so that standard test cases (search, cart, purchase, etc.) could be built once and executed across the family of sites and apps.

Our team customized our test case libraries and created a keyword-driven test system. The same keyword tables drive web and mobile-app tests across the entire test matrix.

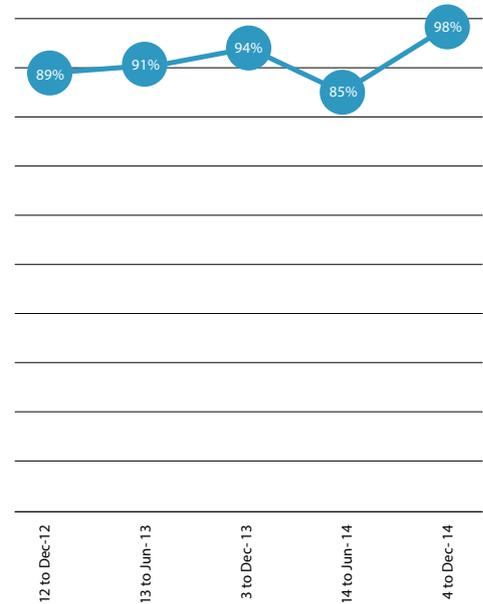
The client measured the following outcomes:

- A 6.5% increase in orders was attributed to improved software quality(!)
- Release testing was accelerated from 5 days to 2 days through automation.
- Even with twice as many software releases, the number of testers needed was reduced from 7 to 3, resulting in more than \$500k cash savings.
- Production-support costs declined by approximately \$250k due to improved software quality.
- Test development effort was reduced from 8 hours per test case to 3.5 hours, a 56% reduction.

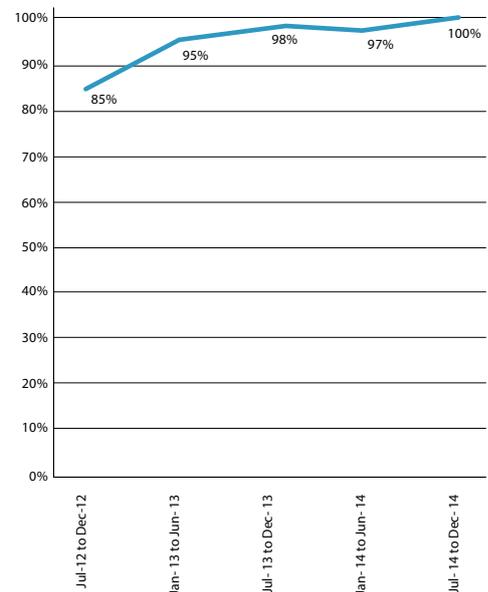
Some project highlights include:

- 98% defect acceptance rate, despite a temporary dip between Jan-14 to Jun-14 due to requirements change and higher bug rejection in below modules, has saved the client from having to chase false positives.
- Defect Removal Efficiency (DRE) improved from 85% to 100% in the 2-year duration
- 100% defect acceptance rate, after an initial learning period, has saved the client from having to chase false positives.
- A Requirements Traceability Matrix, introduced by the eInfochips team, allows the client to track requirements, test cases, and bugs found.
- Customization of the client's JIRA bug-tracking tool dramatically improves defect reproducibility.
- Load & performance testing with JMeter, along with detailed analysis of Average Response Time, Throughput and Deviation, enabled the client to make improvements that have led to higher sales conversion.
- Migration from legacy commercial test tools to modern open-source technologies, managed by the eInfochips team, got the client better functionality at substantially lower cost.

#### Defect Acceptance

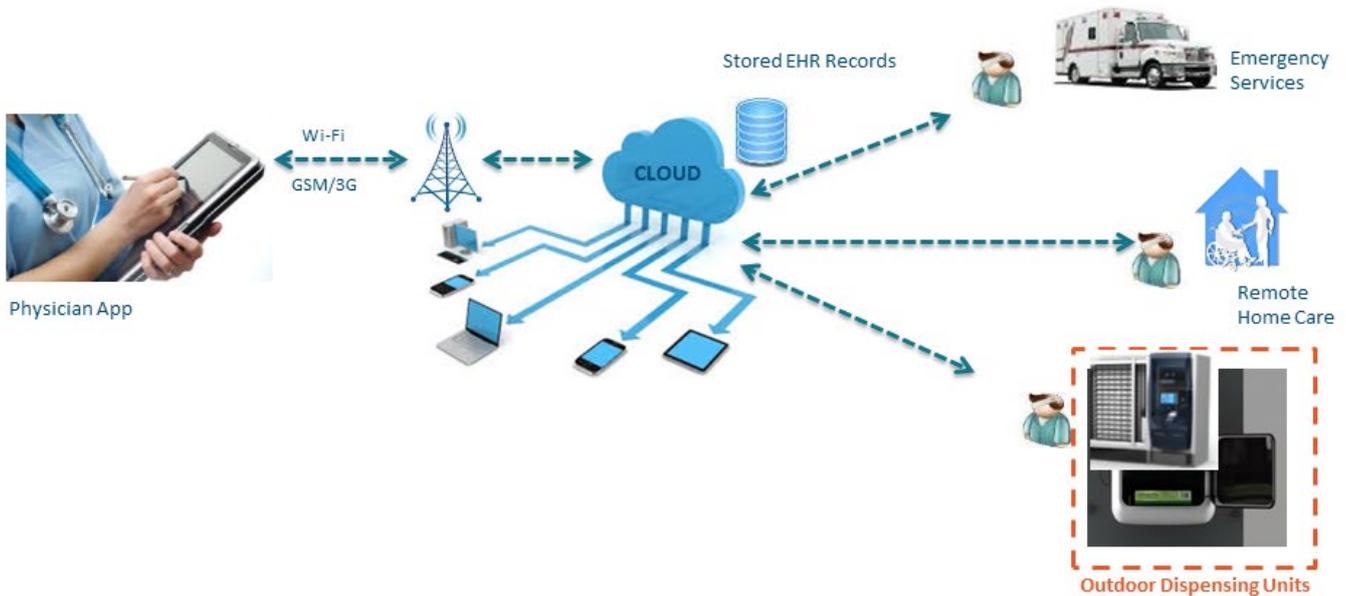


#### Defect Removal Efficiency (DRE)



## PROJECT 2: MEDICATION KIOSK + PHYSICIAN REMOTE DIAGNOSIS

We were engaged to develop a pioneering IoT kiosk for a pharmaceutical-company client. The novel machine, currently in regulatory review, can dispense prescription medications directly to patients in acute need. It includes video communication capability allowing a remote physician using a mobile app to communicate with the patients for remote analysis; secure capability for the physician to trigger dispensing; and sophisticated inventory management to ensure availability and facilitate recalls.



### SOLUTION OVERVIEW

Remote Drug Dispensing Unit

Smartphone App

SIP App

Wi-Fi/3G/IP

EHR Cloud Storage

Video Analytics

Our team did the complete development and validation of the device, app, and backend systems. Test automation highlights include:

- 1100 test cases developed, covering end-to-end system functionality
- 60% of test cases automated, covering essentially all automatable cases

(Note that in this case there are both regulatory and technical reasons why a larger-than-usual fraction of test cases are not suitable for automation. Together with the client we determined that 60% was an appropriate level of automation.)

## PROJECT 3: HOME SECURITY SYSTEM

eInfochips developed more than 6500 test cases for this project, delivering a client-estimated \$2.5 million in savings through defect detection, prediction and prevention. In three years of production experience, there have been no critical or major defects reported in the field, which implies a 100% Defect Removal Effectiveness for these severities.

## CONCLUSION

In the real world, most development organizations accumulate technical debt. This paper has discussed how one form of debt – lack of sufficient test automation – can be addressed by a parallel team from a contract supplier like eInfochips, while your internal team continues on roadmap development.

Future papers in this series will discuss how work can be structured to retire other classes of tech debt – stay tuned!

To subscribe to this series, or if you have questions or comments, email us at: [techdebtzero@einfochips.com](mailto:techdebtzero@einfochips.com)

## ABOUT eInfochips

eInfochips has helped hundreds of clients develop successful software products in industries including Retail & eCommerce, Media & Broadcasting, Security & Surveillance, and Home Automation, among others. Recognized as a leader in test engineering, eInfochips has also been selected to perform independent validation and verification (IV&V) services for can't-fail products including medical devices, aerospace flight systems, and industrial automation robots.

The company has a proud 20-year history, focused exclusively on R&D services for product companies. We have grown organically over that time to more than 1500 engineering, serving clients from our US headquarters in Sunnyvale, California and from sales and design centers across the US and India. In addition to our 200-strong test engineering team, we have teams offering the full range of product development services, including software development, system and PCB design, VLSI and mechanical engineering. (We started in VLSI, which is why our name has "chips" in it – but more than half of our business is software these days.)

Clients engage eInfochips for projects as small as a one-time test-backlog reduction or as large as a full turnkey product design.

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