

# HomeAway's Transition to Software Product Line Practice: Engineering and Business Results in 60 Days

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## Abstract

*The genesis of HomeAway, Inc. was startup by accretion – eight companies in the web-based vacation home rental market were acquired and merged. The technical solution during the merger and acquisition phase was to assimilate the software functionality of each of the eight companies into a one-size-fits-all application that could be configured with runtime settings to support the look-and-feel of the original eight. When rapid growth and an aggressive business plan pushed the one-size-fits-all approach beyond its limits, HomeAway decisively applied the 3-Tiered Software Product Line (SPL) Methodology and the Gears Unified SPL Framework to transition to a Software Product Line practice. This case study explores how HomeAway leveraged the 3-Tiered Methodology and Gears to make their transition, accelerate software development, reduce defect density, lower development overhead, and extend the scalability of its portfolio to better achieve its aggressive business goals – all within 60 days.*

## 1. Introduction

The 3-Tiered SPL Methodology™[1] is based on a tiered progression of SPL capabilities and a resulting progression of benefits. As organizations shift from conventional product-centric software development to SPL development, the three tiers of capabilities and benefits are established, sometimes in sequence and sometimes in parallel. Each tier builds upon and is enabled by the capabilities and benefits of the previous tier.

The base tier provides a very tactical set of developer capabilities and benefits, which enables a middle tier of engineering management capabilities and benefits, which ultimately enables the top tier of highly strategic capabilities and benefits for the business operations:

- **Base Tier:** *Variation Management and Automated Production.* First class variation management and a

fully automated production line deliver optimized developer productivity and significant reductions in per-product development cost.

- **Middle Tier:** *Core Asset Focused Development.* Shifting from product focused to core asset focused development enables the portfolio to be developed as a single system rather than a multitude of products. High levels of software reuse and deep core asset expertise are the result, leading to optimized product quality.
- **Top Tier:** *Feature Based Portfolio Evolution.* As the business transitions from product based to feature based portfolio evolution – where the entire portfolio evolves by adding or modifying feature requirements – the result is extremely efficient collaboration and between the business and engineering teams, leading to faster time-to-market and increased product line scalability.

*This is the story of one company's experience applying the 3-Tiered SPL Methodology.*

### 1.1. HomeAway and the 3-Tiered SPL Methodology

In October of 2006, HomeAway's engineering, management and executive teams – with full support of its Board of Directors – made the decision to deploy an SPL approach, and to show both the engineering and business benefits of doing so – all within 60 days. They were able to achieve this unprecedented objective by initially focusing on the base tier of the 3-Tiered Methodology, *Variation Management and Automated Production.*

In growing from a startup to an enterprise, HomeAway's software assets and engineering processes needed to likewise mature. The move to SPL practice was a critical part of this process. After the base tier capabilities were established, the middle tier of the 3-Tiered Methodology, *Core Asset Focused Development,* enabled HomeAway to very effectively address the needed refactoring, re-architecting, modularization, and re-engineering. HomeAway's

innovative adaptation of the middle tier provides proof that it can be most effective to adopt a product line approach prior to any re-engineering of existing assets.

During the rollout of the SPL approach, HomeAway's Product Marketing team soon recognized the potential strategic impact of the capabilities delivered in the top tier of the 3-Tiered Methodology, *Feature Based Portfolio Evolution*. Better clarity began to emerge in the features specifications. Existing ambiguities were located and resolved. Innovative new instances of web sites were conceived based on subtle but powerful feature profile differentiations – an unlikely occurrence with the pre-SPL mindset. For HomeAway, the emerging business benefits such as these serve as the ultimate metric for success.

## 2. HomeAway Background and Business Model

HomeAway, Inc. is the worldwide leader for vacation rentals on the Internet. Each year, more than 50 million travelers visit the HomeAway sites and choose from more than 130,000 vacation rental homes across 100 countries. For an annual fee, homeowners and property managers can use HomeAway and receive the best return on investment in the industry and the opportunity to reach the ever-increasing number of vacationers who choose rentals as their preferred accommodations.

### 2.1. HomeAway History

HomeAway was founded in 2005 by Brian Sharples, who realized that vacation rentals represented a market on the Web that was fragmented, underexposed, and underdeveloped. There was no consolidated, easy-to-use vacation rental e-commerce web site in this niche market. The time was ripe for a leader to step in.

Industry data supported this intuition. In 2005, vacation and investment homes accounted for four out of 10 home sales according to the National Association of Realtors – and, long popular in Europe, the interest in staying in a vacation home among U.S. travelers continues to grow. In fact, the North American market for vacation rentals and timeshares is approximately \$20 billion in gross travel bookings, according to travel research firm PhoCusWright.

Fueled by venture capital, HomeAway built the foundation for its site by purchasing six companies and their web sites – four in the United States, one in the United Kingdom and one in Germany – in 2005. Following a massive infusion of \$160 million (the largest financing of an Internet software and services company in the U.S. in 2006, according to Standard & Poor's Capital IQ) HomeAway purchased its largest

competitor and their web site in November, 2006. A French company was added to the family in January of 2007. In addition to paying for acquisitions, the new investment funds helped to boost marketing efforts to grow site traffic, and to consolidate and merge the assets and operations of the portfolio of companies. Figure 2 illustrates the HomeAway historical timeline.

### 2.2. HomeAway Today

Today the HomeAway portfolio of vacation rental sites includes HomeAway.com, as well as VRBO.com, CyberRentals.com, AllVacations.com, GreatRentals.com, TripHomes.com, HolidayRentals.co.uk (UK), HolidayRentals.fr (France) and FeWo-direkt.de (Germany).

Through an easy-to-use interface, owners and managers can automatically update property listings across all sites, including adding or removing properties, change description information and communicate with interested travelers. HomeAway's marketing programs leverage traditional and online media to attract more travelers to HomeAway and the European sites, delivering increased exposure, inquiries and reservations.

Sharples says that HomeAway's goal is "expanding the market by making it as easy as possible for travelers to locate, compare and secure properties through the Internet."

## 3. Meanwhile, in the engineering wing...

HomeAway's acquisition and assimilation strategy was to keep the identity, as well as the look and feel, of the various web sites intact. And HomeAway could have simply let the independent web sites remain independent, but the duplication of engineering overhead that would result from multiple, independent development efforts was not going to recoup the investors' money. Nor was it going to secure future investment; The final, massive infusion of funds that put HomeAway over the top came only after a wide variety of new features was added across all of the sites, and revenue began to rise as a result. In order to accomplish this capability, HomeAway had to consolidate the web sites' software to produce an integrated software base that could accommodate the roll-out of new features quickly and often.

The initial startup approach was to simply merge the software into a *one-size-fits-all* system, an approach that results in a single executable piece of software. In HomeAway's case, the executable took the form of a ColdFusion application. The site variations were handled with runtime selection mechanisms: "If we're *this* site, then behave *this* way. If we're *that* site, then behave *that* way," and so forth.

February 2005	Co-founders Brian Sharples and Carl Shepherd create WVR Group, Inc. in Austin, Texas. WVR Group receives \$32 million in funding from Austin Ventures and Redpoint Ventures and \$9 million from WVR management.  WVR Group acquires CyberRentals (site founded in 1995 in Vermont), GreatRentals (founded in 1997 in Michigan), London-based Holiday-Rentals (founded in 1996), Rent101 (founded in 1999 in New York) and changes the name to TripHomes, A1Vacations (founded in 1998 in Virginia)
December 2005	WVR Group acquires Kassel, Germany-based VacationVillas which operates <i>www.feWo-direkt.de</i> (founded in 1997).
May 2006	WVR Group receives \$7 million in funding
June 2006	HomeAway launches its U.S. flagship vacation rental site, <i>HomeAway.com</i> , which includes properties from CyberRentals, GreatRentals, A1Vacation, Holiday-Rentals and TripHomes.  WVR Group changes name to HomeAway, Inc.
September 2006	<i>USATODAY.com</i> selects HomeAway to power its online vacation rental classifieds.
November 2006	HomeAway receives \$160 million in equity and debt financing to fund expansion initiatives in the United States and Europe.  HomeAway acquires <i>VRBO.com</i> (founded in 1995 in Colorado), its largest competitor.
January 2007	HomeAway acquires Aritel.fr SA of France. With the addition of the Aritel site, HomeAway now has listed more than 160,000 homes across 100 countries.

**Figure 2. HomeAway corporate timeline**

This approach was very much easier said than done. Each of the original sites used different software systems to produce web pages, different database engines, and of course different data formats and layouts. The data migration problem alone was formidable, but it had to be done. The decision was made to use the London system as the common platform. It featured a homegrown content management system, which (among all of the sites) allowed for the fastest creation and modification of web page content. More importantly, this system enabled the engineering team to manage the content of different sites separately, but under a common infrastructure umbrella.

The software merge was brought about with significant effort. The platform architect established some conventions for handling variations, such as a standardized *company switch* that made it easier to express runtime choices among the site differences. However, these conventions were difficult to follow and enforce. Developers were free to use the approach they thought best for each specific situation. A thorough code inspection eventually revealed that over

time 29 separate mechanisms had been introduced for managing variation among the different sites.

As a well-funded startup, HomeAway grew quickly – more engineers, more site variations, more new features, more geographically distributed development teams. The one-size-fits-all approach was eventually pushed beyond its practical limits. The sites worked, but convolution and complexity became the norm. Managing and maintaining the code, especially adding new features, became a daunting challenge. Any change made for any site meant a new executable for all sites. Interdependencies among the sites became harder and harder to comprehend.

An oft-heard lament was “It took me four hours to find a bug that took ten minutes to fix.” And quality was an increasing source of concern. Testing could only cover 10% of the software, and impoverished though it was, this discovered 30 new defects every week – week after week – with no guarantee that fixing one defect didn’t introduce new ones. Code reviews often consisted of the platform architect reading all of the new code that was checked in, a solution that – to say the least – lacked scalability.

And new challenges lay ahead. Previously every site was hosted on its own individual server, but the growth projections called for multiple servers to handle speed and volume of expected transactions on some of the sites, as well as the need for multiple, smaller specialty sites to be hosted on a single server. Installing multi-server configurations at some sites, and changing the software accordingly, was almost inconceivable under the one-size-fits-all strategy. Another daunting change was to make the sites interact with each other so that, for example, for an extra fee a property owner could list a property on all of the sites in the family.

HomeAway engineers had taken their startup approach to its limits. In fact, they had achieved results beyond the complexity limit of what is technically feasible for a rapidly growing portfolio under the one-size-fits-all approach. It was time for a change.

#### 4. Building the Case for SPL Engineering

Change within an organization is hard. Or as Dilbert succinctly put it, “Change is good. You go first.” Even when everyone recognizes that a change is needed, it is often easier to do things today the same way they were done yesterday. Successful organizational change is most often the result of key individuals who are deeply aware the deficiencies of the current way of doing business, that have an keen vision for a better approach, and are willing to do whatever it takes to spearhead change.

Successful transitions to SPL engineering practice characteristically have “champions” and key innovators leading the change from several areas in the organization: engineering leadership (such as a lead architect or systems engineer), engineering management leadership (such as a director or VP of engineering, or CTO), and business and executive leadership (such as a business unit VP or CEO).

HomeAway had all the right ingredients. Their lead architect, Dale Churchett, and their Chief Technology Officer (CTO), Ross Buhrdorf, worked closely together, identifying and implementing the software engineering innovations needed to take HomeAway from a collection of company acquisitions in startup mode to a cohesive and mature engineering operation. In fact, they had a long and successful history working together at previous companies, both large and small, establishing world-class, highly innovative software engineering practices. They brought a solid understanding of SPL methods to HomeAway, having gained experience driving the SPL implementation at Salion, 2004 *Software Product Line Hall of Fame* inductee[2].

Their projects at HomeAway spanned practices across the development lifecycle, for coding, testing,

configuration management (CM), deployment, and so forth. They helped to introduce the agile Scrum methodology, a team-based approach to iteratively, incrementally develop systems and products, that produces a shippable result at the end of each iteration. Processes were introduced to prevent developers from touching software on live servers or data in live databases. The database was “firewalled” by assigning total responsibility to a skilled database administrator, and by largely decoupling the database from the rest of the software – a valuable step towards separation of concerns.

To truly gain control of the software and position it for scalable growth, the engineering team had to gain control over all of the variations – while factoring out and eliminating duplication across all the software that was common to the sites. HomeAway had to establish a true SPL engineering methodology.

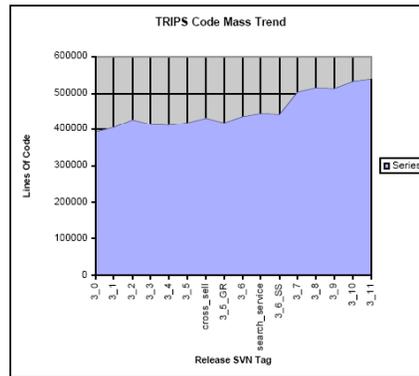
They began to build an engineering case, as well as a business case, for adopting a first-class SPL engineering practice. Through the combination of their previous experience and intuition about SPLs, as well as soliciting external guidance from BigLever Software, they put together a one-hour presentation that told the story.

The first slide set the stage for the message. It simply said “HomeAway is a software product line with a software product line problem.” Subsequent slides laid out the current situation and made a calm, sobering case that current trends with the one-size-fits-all approach could not be sustained. For example, one slide said:

- Each time a new company, brand, language or white label is introduced, one or all of these mechanisms must be modified to accommodate the change, forcing a complete regression test across all products that use those mechanisms.
- If every server contains logic about every product, hot fixing or releasing one product is hard to do in isolation.
- If the code becomes harder to reuse than the effort required to implement a new features developers will tend to invent new mechanisms to get the job done. The architecture will diverge, which compounds the problem.
- Testing is problematic due to the combinatorics of the ways runtime mechanisms change runtime behavior.
- The statistical likely hood of introduction defects due to multiple variation mechanisms is very high.

Figure 3 shows a slide from the presentation that makes the case that HomeAway was on an unsustainable course in terms of the amount of code per release.

The current code trend is one of ever increasing *mass* per release. At some stage the trend must be reversed in order to scale.



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**Figure 3. Slide from the Engineering and Business Case for SPLs**

The presentation then focused on the SPL approach, citing its proven benefits, including:

- Dramatic reduction in code size and complexity
- Greatly increased quality
- Greatly reduced QA test cycles
- Fewer bugs
- Greater stability between products due to loose coupling
- Can create new products in a timely manner
- Greater service uptime with the ability to hit the SLA of 99.9%
- Easier deployments
- Requires core assets to be identified
- Large architectural cleanup is possible with low risk
- Explicit identification of variation points in the system
- Greater opportunity to extract common code from variations

The slide pointed out that “the cost of implementing a variation should be just that of the variation, not somehow proportional to the number of products in the portfolio.” And the good news, the slide concluded, was that the tools and methods from BigLever

Software had a proven track record of doing just that. This was succinctly summed up using the BigLever axiom:

*“Engineer your software product line portfolio as a single system rather than a multitude of products.”*

The presentation concluded with information about BigLever’s SPL development tool, Gears, and showed benefit metrics from other BigLever success stories. The audience was left with a powerful go-forward approach, shown in Figure 4.

Starting in September 2006, a series of twelve presentations were made at all levels of the engineering and business organization, culminating on October 4, 2006, with a presentation to HomeAway’s Chief Operating Officer, Chief Executive Officer, and Board of Directors. The reaction at all levels of leadership was enthusiastically positive.

Applying typical startup timeframes, HomeAway’s executive, management and engineering leadership made a firm commitment in the Board of Directors meeting to adopt the SPL approach and produce tangible engineering and business improvements – within 60 days. The presentation had done its job. Now it was time to make good on the strategy.



What To Do?

We have a classic product line problem that has been documented and studied in numerous large scale organizations. This is a common problem for many companies. “Who builds just *one* thing anymore?”

We are using techniques to manage the complexities of code variations, but we are soon to hit the wall as predicted by SEI case studies (5-10)

The current strategy does not scale, so we must act.

Reactive methods and Gears is low risk and has proven effective at variation management in companies of all sizes  
 Ref: Ingenio (15 – 40 products w/out hiring in 1 year, currently over 90  
 Every 7 days they added a new product without hiring – 1M LOC system)

- Treat variation management as a 1<sup>st</sup> Class Engineering Technique and a core architectural competency as opposed to an implementation level technique.
- Implement a GEARS pilot project
- Change the deployment strategy (instance clustering, vmware)
- Begin refactoring out variation points in the code
- Be ruthless at reducing the runtime mechanisms in the code

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**Figure 4. Conclusion Slide from the Engineering and Business Case for SPLs**

## 5. Results in 60 Days

The decision had been made to deploy an SPL approach and to achieve tangible benefits in 60 days – the clock was running. HomeAway and BigLever Software immediately kicked off the process of planning, training and piloting.

### 5.1. Gears at HomeAway: The first 30 days

The key activities of the first 30 days comprised:

- General training of the whole engineering team regarding SPL concepts
- Defining an incremental rollout plan
- Specialized SPL training for the key personnel that would lead the rollout
- Familiarization of the management team with the motivation and business benefits

Initial developer training consisted of a two-hour presentation on SPL concepts and a demo to illustrate those concepts using the Gears SPL engineering tool. The demo was followed by a two-hour hands-on tutorial using Gears and a presentation that outlined how Gears would be applied in the context of HomeAway. Pilot demonstrations showed Gears being applied to isolated areas of the HomeAway software to drive home the concepts of commonality and variation.

On October 16, twelve days after the Board of Directors meeting, the rollout plan was released. The following two weeks were mainly consumed by previously-existing production commitments.

### 5.1. Gears at HomeAway: The second 30 days

On November 6, one month and two days after the pivotal Board meeting, the SPL rollout began.

Initially, three senior engineers worked together to create the SPL automated production environment by integrating Gears into HomeAway’s existing CM, build and deployment infrastructure. The goal of this effort was to transition from the one-size-fits-all deployment model for each of the twelve sites currently supported by the HomeAway platform to a Gears automated production model. With Gears, each of the twelve sites could be separately and automatically configured, built, tested and deployed.

To bootstrap the effort, the infrastructure required some innovative changes to support the builds, testing and deployments of separate products on developer desktops, test lab machines and official deployment servers. A “no-op” Gears *file variation point* was added to the source repository, simply to verify that the automated Gears production environment was working correctly. This file variation point could be inspected after automated production of a product instance to

verify that it contained the correct product identifier. Once this trivial level of bootstrap capability was operational, engineers could incrementally transition the one-size-fits-all runtime variations into explicit and encapsulated Gears variation points.

Nine days later, on November 15<sup>th</sup>, the Gears-based SPL infrastructure went live in the production development environment. All developers could now do separate builds and deployments for each of the sites, as well as begin using Gears.

There was “low-hanging fruit” to be gathered first. Company switches in the code (“if we’re *this* site, behave *this* way; if we’re *that* site behave *that* way”) were an especially easy target for variation point creation. Using the new SPL infrastructure, when one site was built all of the unreachable code that was specific to other sites no longer needed to be included. Within days, the footprints for the individual sites dropped from 16 megabytes to 11 megabytes or less; one site dropped to 8 megabytes. Eliminating the dead code from each site enabled test coverage metrics to increase by 36%. The geographically distributed site teams could deploy their site instances without the need for branching or full regression testing on all of the other sites. Real opportunities were now within reach to reduce deployment mistakes and speed time-to-market for fixes, enhancements, and new features.

During this initial phase, the Gears *feature model* was used to capture and express the features in the HomeAway application domain that were responsible for the diversity among the different site instances – characteristics like site brand, language localization, and optional site features. One of the early and unexpected benefits from this effort was that it allowed HomeAway to identify and remove the ambiguity that existed in the way Product Marketing characterized and expressed requirements to the engineering team. The feature model provided a more precise means for analyzing, expressing and selecting among the diversity for the different site instances.

By November 30<sup>th</sup>, less than two months after the Board meeting and only three weeks after the Gears rollout began, HomeAway had a true, fully automated Gears software production line and had demonstrated tangible engineering and business benefits – albeit just scratching the surface of the available benefits yet to be attained.

## 6. HomeAway’s Application of the 3-Tiered SPL Methodology

The 3-Tiered SPL Methodology has the flexibility to be applied in different ways at different organizations in order to accommodate the wide diversity that exists in software engineering

approaches. That is, the 3-Tiered Methodology is easily adapted to best suit the unique situation and objectives of each individual company. HomeAway’s adaptation was well tuned to its specific needs.

Recall that the 3-Tiered SPL Methodology comprises these key elements:

- The Base Tier: Variation Management and Automated Production
- The Middle Tier: Core Asset Focused Development
- The Top Tier: Feature Based Portfolio Evolution

### 6.1. The Base Tier at HomeAway

HomeAway was a clear candidate for applying base tier capabilities when BigLever arrived on the scene. They exhibited the classic problem symptoms: Too much time spent on defects and staying above water, and not enough time spent on adding value to the product line.

The base tier, *Variation Management and Automated Production*, provides the foundation for software product line practice. The focus is on the basic infrastructure that promotes variation identification and management to first-class status in the product line. The goal is to provide a uniform mechanism that supports variation points in the software assets, and an automated production mechanism to instantiate products from the feature models, software assets and implementation-level variation points. The Gears SPL engineering tool provides exactly that.

First-class variation management and automated production serve to:

- eliminate duplication, cloning, divergence and merging
- consolidate the multiple ad hoc variation management mechanisms typically found in legacy software
- eliminate the manual and parallel production efforts found in conventional approaches

Gears provides a vocabulary and a conceptual scheme to make variations visible and first-class, which is essential before sound engineering decisions about them can be made. As one HomeAway engineer describes it, “Gears puts a ‘neon sign’ on each of the variations, making them impossible to ignore and giving them their rightful place as a first-class engineering construct in the engineering process.”

The primary benefit gained from the combination of Gears and the methodology’s base tier capabilities is lower development overhead compared to conventional approaches – and as a result, higher developer productivity and lower per-product development cost.

HomeAway's specific objectives for the base tier were:

- Eliminate the one-size-fits-all approach and single executable
- Enable separate and independent builds, testing and deployments for each of the different sites
- Create a smaller runtime footprint for each site
- More efficiently create, evolve, maintain and manage feature variants among the different sites
- Increase test coverage and eliminate redundant regression testing across all sites when only one site was changed

By keeping a sharp focus on the capabilities and benefits enabled by the base tier, the engineering team was able to accomplish HomeAway's objectives to show tangible technical and business results from the SPL approach in only 60 days. Soon after the rollout began, there was evidence that HomeAway was achieving base tier benefits. In the hallways, it was easy to overhear the SPL approach taking hold, such as conversations starting with, "I need to talk to you about this variation point."

Gears provided the capability to determine what products were affected by a change, a boon to testing and deployment activities. Code coverage in testing increased 36% by getting rid of unreachable code in each product. The footprint for each of the sites dropped from 16 megabytes for the one-size-fits-all executable to anywhere from 8 to 11 megabytes. The goal of deploying a single site onto multiple servers and multiple sites onto a single server was now a real possibility and 3 sites initially utilized this flexible deployment model. Site installations, which could take up to 16 hours previously, now took about 15 minutes. Comments such as "I just fixed a bug in Germany and it didn't affect any other site" were common.

As always, there were important lessons learned from the challenges faced during the organizational transition to SPL practice. Because the transition happened quickly in order to achieve 60 day results, and production schedules did not slow down, developers did not have an excess of time to personally reflect on the new SPL development practices. As a result, it was easy to forget the new methods and slip into old practices and habits.

The leaders of the SPL transition maintained watchful vigilance and skillfully guided course corrections during the first several months in order to instill desired SPL practices. For geographically distributed sites that did not have a local experienced SPL leader, these challenges tended to be greater due to the inherent limits in remote interpersonal

communication. As is typical with the 3-Tiered Methodology, the need for vigilance subsided as the SPL methods become routine rather than new. The base tier practices then became stable and self-optimizing.

## 6.1. The Middle Tier at HomeAway

Given its heritage as a fast-paced startup company using the one-size-fits-all approach, it was not surprising that the architecture and implementation of HomeAway's software was monolithic in nature. It was clear that the system needed to evolve to a more modular structure as the company, software, and engineering team grew, matured and transition to the SPL approach. Rather than attempt this re-architecting and re-engineering of the monolith upfront, HomeAway wisely chose to tackle this using an incremental refactoring strategy in the middle tier of the 3-Tiered methodology, *Core Asset Focused Development*, after the basic capabilities of the base tier were established in production. This approach avoided the upfront adoption barrier, characteristic of early generation SPL methodologies, in which systems are re-engineered into core assets prior to production rollout.

The focus of the middle tier is organizing the assets and development teams around the reusable components and subsystems – which are referred to as the *core assets*. The shift from product-centric development to core asset focused development enables engineering management to manage the development of the portfolio as a single system rather than a multitude of products. The primary benefit gained from the capabilities in the middle tier is higher product quality compared to conventional product centric development. This results from high levels of software reuse, deep core asset expertise and stable organizational structures.

HomeAway's specific objectives for the middle tier were:

- Modularize the monolith
- Effectively and incrementally refactor and re-engineer subsystems as SPL core assets
- Utilize the Gears variation point mechanism to prototype and re-engineer "on the tips" of ongoing development rather than on parallel and out of sync development branches
- Establish better organization around core asset teams, particularly across geographically distributed locations

The incremental re-engineering approach was a simple and methodical pattern: Locate the places in the

code impacted by a specific refactoring. Firewall that part of the code by encapsulating it in one or more Gears variation points, so that the “old way” and the “new way” can be temporarily accommodated in parallel. Expand into separate files to disentangle the enumerated variants and factor out the pieces that are common. Create the Gears variation point logic to switch between the variations and use the Gears feature profile for each site to independently switch from the old way to the new way at their earliest convenience. As soon as all sites are using the new way, remove all of the deprecated variants and remove variation points if appropriate. Repeat.

A configuration management *trigger* mechanism was set up so that when anyone changes a variation point, interested parties are notified. This is similar to the *Variation Control Board* concept used by LSI Logic/Engenio in the early stages of that company’s SPL rollout. LSI Logic’s approach used peer reviews to help establish best practices for variation point implementations[3]. Variation points are now the intellectual currency in which everyone has a stake, and the components and site pages are in fact the HomeAway product line’s core assets.

Organizing development teams around core assets rather than products eliminates the need for many or all developers to understand the entire product. Rather, core asset focused development teams can establish deep and narrow expertise. From an engineering management perspective, this organizational structure is very stable. In contrast with *application engineering* approaches in which an organization has to scale with each and every product added to the portfolio, the core asset focused capabilities created in the middle tier allow the organizational structure around core assets to be very stable – regardless of the number of products in the product line. For example, a similar team structure is required for 2, 20 or 200 products.

## 6.1. The Top Tier at HomeAway

The focus of the top tier, *Feature Based Portfolio Evolution*, is business-wide management of the entire software product line portfolio using concepts and terminology based on portfolio features – that is, the feature model.

HomeAway’s specific objectives for the top tier were:

- Faster rollout of new features – new site features were a proven source of new revenue
- Better configurability of features and diversity
- Rapid rollout of new co-branded sites – another proven source of new revenue
- More effective communication between Product Marketing and Engineering regarding requirements for new site features and new products

The tiered structure of the 3-Tiered Methodology might suggest that work on one tier begins after the transition of the next lower tier is complete. However, it is more common that work on middle and top tiers begins after just the basic capabilities of the previous tier have been established. This was the case for HomeAway, where capabilities and benefits at the top tier began to emerge as the middle tier transition was in mid-flight.

During the first 60 days of the rollout, presentations and discussions with the business and management leaders helped them to understand the potential implications on their roles and the positive impact that the top tier of SPL capabilities and benefits could have on the business. Because the concepts of feature based portfolio evolution were new and were fairly abstract in the absence of the base and middle tiers of capabilities, it was not clear how well these ideas could be adopted in practice. However, it soon became evident that the seeds planted early in the process were going to pay off.

HomeAway’s Product Marketing soon recognized the potential of managing portfolio evolution based on features, as clarity emerged in features specifications and several existing ambiguities were identified and resolved. Ideas for innovative new sites began to emerge that likely would not have been conceived from the previous product-centric mindset. For example, different co-branded sites were created based on subtle differences in feature profiles that are oriented towards the different user interactions favored by female versus male users.

Gears makes it a small and straightforward jump from tactical variation points in the base tier to features as the strategic *lingua franca* for managing the entire portfolio in the top tier. And this is the ultimate metric for success for HomeAway. After all, that was always the end game: to produce an “integrated software base that could accommodate the roll-out of new features quickly and often.”

## 7. Conclusions

Using the 3-Tiered Methodology and Gears SPL engineering technology from BigLever Software, HomeAway successfully accomplished the unprecedented objective of achieving engineering and business benefits from the SPL approach in 60 days. The capabilities and benefits at all three tiers continue to expand according to their incremental transition strategy.

The effort has more than paid for itself, and many of the benefits came within a few weeks. Reduced software footprint has lowered hardware requirements. Less complexity has led to greater control, more effective testing, radically reduced deployment times, and higher quality. Greater flexibility (for example, in

server configurations) can be achieved on the sites, and changes can be made on one site without affecting others, allowing lucrative new features to be deployed faster and with a lower regression testing burden. Innovative new sites with feature profiles finely tuned to cultivate narrow market segments can be conceived, designed and deployed with dramatically less time and effort. Here's how an engineer put it in a recent e-mail:

*“ I really don't think its gonna be that much effort to add the functionality... probably most of the work would be migrating your existing CMS labels into the new structure..... since this is 'varianted' code changes galore can happen on VV that will not affect any of the other sites (and thus reduce regression [testing]!) - oh the wonders...!!!”*

## References

[1] Charles W. Krueger. *The 3-Tiered Methodology: Pragmatic Insights from New Generation Software Product Lines*, in Proceedings of the 11th International Software Product Line Conference, Kyoto, Japan. September 2007.

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[3] William A. Hetrick, Charles W. Krueger and Joseph G. Moore, *Incremental Return on Incremental Investment: Engenio's Transition to Software Product Line Practice*, October 2006, OOPSLA 2006, Portland, Oregon, ACM.