Process Mass Customization in a Global Software Firm

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Abstract

Although process technology has become widely adopted across the industry, software engineering remains a complex activity. Software firms must therefore ensure managers and engineers can easily tailor software processes to meet specific needs [1]. A software process is a set of serial and parallel activities that together creates value for the software product (e.g. a flow describing business decisions from start to final product or how to manage a prioritized requirements backlog) Software processes may be tailored to particular technologies [2], they may be tailored to particular organizational contexts [3], and there are generic models available for tailoring processes to specific project goals and environmental factors [1]. However, while some level of process tailoring is always necessary, it may be a costly activity requiring considerable effort by both process developers and consumers.

This problem needed to be addressed within Ericsson’s increasingly global software operation. Ericsson has been committed to process technology for a couple of decades with a strong focus on ensuring software processes are actually used to support both quality and productivity [4]. This commitment has increased even more during the last decade where implementations of agile and lean processes have become a competitive edge for quality and productivity [5]. However, as Ericsson’s software projects typically involve managers and engineers from several locations around the world, it has become both difficult and costly to ensure appropriate software process tailoring. As a result, Ericsson looked at how other industries apply mass customization [6] to effectively serve different needs of individual clients. We found that globally distributed software firms can benefit a lot from adapting different tactics from mass-customization theory to more effectively deploy its software processes to different contexts.

Keywords

Software Engineering, Software Processes, Software Tailoring, Mass Customization

A Global Software Firm

Product development is globally distributed within Ericsson as illustrated in Figure 1. The particular organization addressed here includes sixteen different product units with typically 200-600 managers and engineers working on each product at
three-four sites located across different time-zones. The products are complex and have evolved over many years, often including over one million lines of code. The organization of development activities for each product depends on a number of factors, including markets, customers, company acquisitions, costs and competencies. In addition, there are technical dependencies between many products because they share platforms or components. Each product organization has typically one main site and two-three supporting sites. The software processes that support these efforts are mainly developed at the main site. There are typically two-three process developers per product at the main site (called main process developers) and typically one-two process developers at each supporting site (called supporting process developers). However, the availability of process developers differs from product to product. Process alignment, sharing and learning therefore needs to be managed in different ways across locations and products.

Given this complexity, it is challenging and costly to ensure Ericsson’s portfolio of software processes is effectively tailored to the many different situations in which processes are used. A rough estimate suggests Ericsson currently manages ~100 different software processes and that each of them at any moment in time is used in ~1000 situations across different products and locations. One process may include a flow describing business decisions for a software feature from idea to delivery and another may describe details for how to work with continuous integration. Some processes are aimed at supporting all 16 products, while other processes are specific for one single product. Instead of continuing to support traditional process tailoring, process developers therefore decided to explore the opportunities offered by mass customization [6].

![Figure 1. Globally distributed product development](image)

The data presented in the following was collected based on interviews, participatory observations and direct involvement, while the data analysis was based on triangulating between these different data sources driven by mass-
customization theory and collaboration between an insider researcher (Anna Sandberg) and an outsider researcher (Lars Mathiassen).

**Mass Customization**

The idea of mass customization emerged in the late 1980s to help firms provide customized products and services in high volumes and at reasonably low costs [6]. Mass customization has since been adopted as a competitive strategy by an increasing number of firms and it is well worth exploring how it may apply in contiguous areas. Gilmore and Pine [7] have identified four specific mass-customization tactics (adaptive, cosmetic, transparent and collaborative), which process developers at Ericsson have started to interpret, adapt and apply to improve and streamline their approach to software process tailoring. Table 1 summarizes the four tactics, how they may be adapted to software process tailoring, and some reflections from applying them to implement new agile and lean software processes within one particular product unit at Ericsson consisting of ~6000 employees at ~20 sites across the globe. Key experiences and lessons are detailed in the following.

Table 1. Mass-customization tactics adapted to software processes

<table>
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<tr>
<th>Mass-Customization Tactic</th>
<th>General Definition[6]</th>
<th>Adapted to Software Processes</th>
<th>Experiences from Practice</th>
<th>Benefits for Practice</th>
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| Adaptive                  | Offer one standard, but customizable, product that is designed so that users can alter it themselves | Configure a software process into mandatory and optional parts so process consumers can choose if and how they want to address the optional parts | • Used when not reflecting over what tactic to use  
  • Difficult to balance mandatory and optional parts  
  • Requires access to supporting process developers | • Valuable when deploying a process fast cross many global sites  
  • Manageable tactic for main process developers  
  • Appreciated tactic for process consumers who can locally decide upon optional parts |
| Cosmetic                  | Present a standard product differently to different customers | Represent and communicate the same software process in different forms and using different media for different process consumers | • Used when main and supporting process developers can work together  
  • Requires in-depth communication analysis by process developers | • Valuable when assuring full implementation and usage at the local sites  
  • Manageable tactic for the supporting process developers  
  • Useful for process consumers who receive information tailored to their environment |
| Transparent               | Provide individual customers with unique goods or services without communicating explicitly that those products and services have been customized specifically for them | Provide a specific group of process consumers with a version of a software process specifically designed for them | • Used to service specific process consumer groups  
  • Requires in-depth situation analysis by process developers  
  • Requires extensive main and supporting process developer resources | • Valuable when having different sites with quite different needs  
  • Manageable tactic for the supporting process developers  
  • Useful for process consumers who get their specific needs fulfilled |
The Adaptive Tactic

In 2010, this highly distributed product unit within Ericsson created a generic process framework to speed up migration of agile and lean practices across its many sites [8]. The framework visualized and explained key areas and core principles and it was developed based on Ericsson material on agile and lean development and inspiration from across the involved Ericsson sites. The framework was designed in such a way that managers and engineers at a specific site could create their own software processes based on context and maturity. To do so, they were guided by specified, mandatory principles and they could then choose the way and the extent to which they would detail each principle.

One site immediately found a way to interpret and implement the framework that proved beneficial to them. Their adaptation of the framework inspired other units at other sites. Over time, more than ten product development units created their own software processes guided by the framework, while a few units did not see any benefit in using the framework as guidance. The generic framework was also used to self-assess agile and lean implementation progress to help a site maintain an overview of implementation progress for the new software processes.

This adaptive tactic offered a set of general, customizable processes that users could fit to their particular needs and circumstances. The framework was successful in terms of providing different sites within the unit with a common terminology for debating, deciding and measuring how to implement lean and agile practices. The framework was partly successful in inspiring the ~20 involved sites across the globe to actually implement new processes. An adaptive tactic like this requires considerable design efforts from the main process developers, but the follow-up efforts are minimal. Moreover, both the supporting process developers and process consumers appreciate the opportunity it affords to shape processes based on local needs. The adaptive tactic is, however, dependent on supporting process developers that are willing to engage in local tailoring activities. When there is a lack of these resources, the adaptive tactic is seldom successful.
The Cosmetic Tactic

In 2011, the same Ericsson unit launched a process initiative to further strengthen deployment and usage of the agile and lean framework across its many sites. Two main process developers organized a tour to visit ten of the sites and hold all-employee presentations about the framework and its implementation. Before each presentation, the main process developers held a meeting with the leadership team and the supporting process developers at that site to understand the context and local level of process maturity. Together, they then designed a presentation to pin-point the areas of high importance to that particular site that also included presentations from local managers within the unit. These presentations communicated the rationale for agile and lean processes and presented a way forward tailored to the site context and maturity. For more mature agile and lean sites, the presentations would focus on details of how to improve existing practices, while sites in the early phases of implementing agile and lean processes would receive presentations focused on the underlying rationale and the involved principles.

This cosmetic tactic presented the standard process framework differently to different users. The initiative was successful in that it was designed to fit local contexts and challenges. It was easier for process consumers to grasp the message as it pin-pointed areas which they were concerned with and also because their own managers took part in delivering the message. However, the initiative was time-consuming and costly. It required that two main process developers travelled across the globe and carefully engaged in many different local situations with their own set of complications: a particular set of key activities and product deliveries at each site, local managers being away on business trips, and finding supporting process developers to help organize presentations and meeting arrangements. The cosmetic tactic is in this way quite time-consuming for the main process developers and it is therefore used more rarely at Ericsson. Still, it is highly appreciated by both supporting process developers and process consumers and quite helpful in facilitating process deployment. In fact, as the local managers got help with the initial tailoring of the messages to include when giving presentations, they became more inspired to continue driving the improvements forward.

The Transparent Tactic

In 2012, one specific product developing site within the same unit wanted a cohesive approach to deploy the concept of ‘empowered teams’, which is a key area within the adopted agile and lean process framework. Two process developers working with the unit’s framework organized five workshops with two supporting process developers and one local manager to discuss and design material to be posted for visual communication and to support training sessions. As the area ‘empowered teams’ applied to all sites across the unit, a draft version was sent out for review to other sites, which helped improve both the content and
the way it was communicated. Although the material was developed specifically to this one site within the unit, other sites also found it useful over time and requested their own version of the material. However, due to lack of main process development resources, these sites were encouraged to adapt the material themselves with help of their supporting process developers.

This initiative provided one particular site with unique processes for ‘empowered teams’ without making it a key point that the material was developed explicitly for them. The initiative was successful because it was initiated on direct request from supporting process developers who used the material immediately. Moreover, the process consumers felt their requests were given highest priority throughout, especially when the review of the new process was handled by the supporting process developers based on the site’s specific needs. The transparent tactic was also successful in that other sites made use of and further adapted the material. So, although the initiative was time-consuming for the involved main process developers, the material was in the end used by many sites and the return of investment was satisfactory. Still, additional involvement of main process developers could have provided process consumers at more sites with unique variants.

The Collaborative Tactic

In 2012, one main process developer wanted to start an initiative to support process developers at each site with knowledge of how to best deploy and implement agile and lean processes. The process developer organized bi-weekly meetings fit for different time-zones over a four months period and all supporting process developers were invited to participate based on interest and availability. At each meeting, the process developer coached the local colleagues by sharing own experiences or asking others to share theirs. On average, eight supporting process developers from four different sites joined each meeting. The meetings were finalized by the question ‘How useful was this meeting for you?’ and on a five point scale the average answer was 4.1. After the meeting series ended, a group of five local process developers from four sites decided to continue on their own.

This initiative offered a dialogue with process developers across sites to help them articulate their needs and identify offerings that would fulfill those needs. Each supporting process developer felt their problems were in focus while at the same time having the opportunity to listen to other colleagues with similar challenges. The initiative was successful in that it facilitated close collaboration between process developers across sites to address the particular needs in each specific context. The initiative was rather time-consuming to organize, but with its emphasis on ‘coaching the coaches’, it was considered a good investment.

Choosing the Right Tactic
The four mass-customization tactics can be characterized depending on whether they require ‘change in the process itself’ and ‘change in how the process is represented’ (See Figure 2). Drawing on this classification suggests that less change in process or presentation requires less effort, while more change requires more effort—with effort referring to both main and supporting process developer resources. This overall framework for choosing between tactics is important, because process developer resources typically are scarce and highly sought after. More detailed comparisons of the four tactics provide further insights into why and when each tactic may be the most, or least, beneficial to use.

Figure 2. Tactics According to Required Change in Process and Representation

The adaptive tactic is very appealing because it requires the least effort from the main process developers. In situations where it is important to diffuse a process fast in a global environment, the adaptive tactic is attractive both from a cost and speed perspective. Main process developers design the process with mandatory and optional parts, and supporting process developer can then tailor the process taking specific circumstances and needs into account. Hence, the adaptive tactic requires supporting process developers who are willing and able to adapt and implement a centrally developed process. However, main process developers cannot always make appropriate distinctions between what should be optional and mandatory process features because they lack sufficient knowledge about variations across local contexts. To be really useful, the adaptive tactic may therefore require process revisions and iterations based on feedback from local
process developers. Another draw-back with the adaptive tactic is that it, because of its immediate attractiveness to main process developers, often is adopted as the pre-defined approach to tailoring without due consideration of other mass-customization tactics. Busy main process developers may forget to think about the required effort of supporting process developers, although the adaptive tactic may be useless without their active involvement.

The cosmetic tactic is the most successful tactic from a deployment perspective. The great advantage is that a process is communicated targeting the specifics of where it is to be deployed, and it is therefore easier for process consumers to understand the process and its impact on practice. The cosmetic tactic requires collaboration between main and supporting process developers to understand differences between central and local perspectives and traditions. It is this collaboration which eventually will make the cosmetic tactic beneficial for process consumers. Hence, the tactic requires main and supporting process developers who are willing to interact and make a joint effort to have processes effectively deployed across different practices. The obvious draw-back is that it is very time-consuming, especially for the main process developers. In many cases, they may not have the time and resources required to engage effectively with all the different supporting process developers. Also, the main developers may not have requisite commitment and communicative skills to make the cosmetic tactic effective. In practice, the cosmetic tactic is therefore used too seldom missing out on an opportunity to effectively reach out to process consumers and make change happen.

The transparent tactic is good to use in response to specific local needs that, at a later point, may have relevance for other local practices. Using this tactic, main process developers interact directly with the supporting process developers and engage fully in their local problems in response to their request for specific process capabilities. In parallel, the main process developers need to reach out to other supporting process developers to recruit appropriate reviewers and to increase the likelihood that the process eventually may be useful for others. The main draw-back of the transparent tactic is that many different local groups may ask for dedicated assistance and there are only limited time and resources available centrally. Hence, by combining the transparent tactic in the early phases with the adaptive tactic in later phases, main process developers may satisfy one local organization’s specific needs while at the same time providing guidance to other contexts. Such a combined approach could help main process developers adopt the transparent tactic more often. So, main process developers need to reflect over the benefits of spending time on one consumer group up front in order to later save time by supporting many groups at the same time.

The collaborative tactic develops and presents unique processes for specific local needs. It should therefore be considered carefully, because it is cumbersome and time-consuming for the main process developers. The up-side is that it gives the main process developers deep insight into the real challenges
and opportunities that exist locally. These insights will help them stay knowledgeable about practices and avoid becoming too theoretical and detached. The draw-back is that the main process developers need to prioritize among different local needs and situations and quite often, this prioritization is non-trivial. From a supporting process developer perspective, this tactic is very appealing as it helps them develop and present processes that target local needs, but still comply to high level strategies and requests within the global firm. The collaborative tactic is best suited when main process developers have dedicated resources to support one or more local organizations. Still, it is also the tactic that requires most experience from the main process developers as they must be able to dynamically sense and respond to different needs in different context over time.

Implementing Mass Customization

For a global software firm like Ericsson, it is important to make appropriate process capabilities available across many different organizational units and geographical sites. While it is always important to have dedicated process development resources, it is equally important that available processes are tailored to specific circumstances and needs. Otherwise, it is quite likely software engineers and managers will not take advantage of the benefits a process culture affords. Realizing this persistent challenge in a global software firm, process developers at Ericsson have adapted general industrial tactics to mass customization to the software context [6, 7]. By applying these tactics within one particular, global product development unit they have come to understand the relative strengths and weaknesses of adaptive, cosmetic, transparent and collaborative mass customization, and they have started to deploy these tactics within each of their product development units. Realizing that today’s best practice is to tailor processes without any conscious consideration of tactics the experiences at Ericsson suggest the following action principles for implementing process mass customization:

- **Favor process consumers.** To ensure effective process deployment, managers and process developers must appreciate process consumer needs across many different contexts and strive to satisfy those needs.

- **Move beyond tailoring.** To effectively apply available process resources and skills, managers and process developers must know how to translate different mass-customization tactics into deployment of new processes (Table 1).

- **Adapt mass-customization.** Different degrees of change in process content and presentation call for application and combination of different mass customization tactics (Figure 2).
Ensure requisite resources. It is important that the requisite configuration of main and supporting resources is identified, committed and orchestrated to support specific mass-customization efforts.

Use incremental approach. To support successful implementation and to take variations across products into account, managers and process developers should implement mass-customization tactics incrementally, starting with one product and leveraging those insights to include other products.

Cultivate process developers. Cultivate the transition to mass customization by involving main and supporting process developers in adapting the tactics and by extending their tool boxes through requisite training.

Roughly three decades ago, the software industry started to adopt ideas from continuous process improvement in other industries. Today, these ideas have been successfully developed and applied across the industry. Still, there are important practical challenges related to managing resources and effectively deploying software process, in particular in the context of global software firms with many competing interests and considerable variations across organizational units and geographical sites. We have argued that adopting mass-customization tactics from other industries as a complement to ideas about continuous process improvement may help address some of these challenges and make software process investments more worthwhile and feasible to manage. The awareness of different tactics and the ability to make conscious decisions on what tactics to use when are keys to successful software process deployment in globally distributed firms.

References
Bios

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