MASS CUSTOMIZATION OF TEACHING AND TRAINING IN ORGANIZATIONS

DESIGN PRINCIPLES AND PROTOTYPE EVALUATION

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Mass customization of teaching and training in organizations Design principles and prototype evaluation

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Mass customization of teaching and training in organizations

Design principles and prototype evaluation

Abstract

In search of methods that improve the efficiency of teaching and training in organizations, several authors point out that mass customization (MC) is a principle that covers individual needs of knowledge and skills and, at the same time, limits the development costs of customized training to those of mass training. MC is proven and established in the economic sector, and shows high potential for continuing education, too. The paper explores this potential and proposes a multidisciplinary, pragmatic approach to teaching and training in organizations. The first section of the paper formulates four design principles of MC deduced from an examination of economics literature. The second section presents amit™, a frame for mass customized training, designed according to the principles presented in the first section. The evaluation results encourage the further development and use of mass customized training in continuing education, and offer suggestions for future research.

Keywords

mass customization,

teaching and training in organizations,

learner involvement,

training modularity

Mass customization of teaching and training in organizations

Design principles and prototype evaluation

1 The design of mass-customized learning

1.1 Rationale

In search of methods that improve the efficiency of teaching and training in organizations, several authors (Fried, 2008; Gabriel, Gersch & Weber, 2007; Mulder, 2005; Waslander, 2007) point out that „one-size-fits-all" learning environments, either in electronic or in traditional form, scarcely consider individual workplace requirements and problems, previous knowledge and interests, and tend to be regarded as low-grade and impersonal by both individual learners and organizations. These authors call for the implementation of customized teaching and training methods for continuing education. On the other hand, the customization of any product, including services and education, is known to considerably increase costs. Mass customization (MC) method can potentially solve this dilemma, as is already proven and established in the economical sector (Da Silveira, Borenstein & Fogliatto, 2001; Piller, 2003; Pine, 1993). MC might have high potential for education, too, however, there are still not enough studies to demonstrate this.

This paper explores the potential of MC for continuing education, and proposes a multidisciplinary, pragmatic approach to teaching and training in organizations. The

first section formulates four design principles of MC deduced from an examination of economics literature, in order to provide a better understanding of how training can be mass customized. The second section presents amit™, a frame for mass customized learning, which makes it possible to adapt training to fit individual workplace requirements according to the principles presented in the first section. Two case studies show the implementation and the evaluation results of amit™ in public administration and in a medium-sized company with a total number of approximately 500 training participants. Thus, the authors aim at bringing the practice of continuing education into closer contact with methods and tools from the economics and computer science.

1.2 The economical definition of mass customization

Understanding MC as a didactic model requires an overview of its original, economic definition. Stanley Davis (1987) who formulated the concept for the first time placed it into the field of Operations Management. MC dwells on the process of designing and producing individual programs and choices within the scope of mass production. It promises the best balance between customer preferences and product features, and it fulfills the increasing desire for individuality (Pine & Gilmore 2000; Reichwald & Piller 2002). Tu, Vonderembse and Ragu-Nathanb (2001) define MC as “the ability of a firm to quickly produce customized products on a large scale at a cost comparable to non-customized products”. Further MC researchers such as Da Silveira et al. (2001), Huang, Kristal and Schroeder (2008), Liu, Shah and Schroeder (2006), McCarthy (2004) and Pine (1993) support this definition. The ‘product’ can comprise

material goods (e.g. cars, clothes, food etc.) as well as services (Pine, 1993). Teaching obviously belongs to the latter category.

Duray, Ward, Milligan and Berry (2000) argue that

> "the essence of MC lies in resolving the seeming paradox of mass producing custom products by finding efficiencies in two key dimensions. First, mass customizers must find a means for including each customer's specifications in the product design. Second, mass customizers must utilize modular design to achieve manufacturing efficiencies that approximate those of standard mass produced products."

According to this approach, MC can be identified and classified based on two characteristics: the point of the customer involvement in the production process and the type of modularity the product offers.

The point of customer involvement. The production cycle includes (1) the design, (2) fabrication, (3) assembly and (4) use of the product. In this chain there is a point where the contact between provider and customer takes place. The customer loses anonymity and turns into an individual with specific needs and production requirements. In classical mass production, the product is first made to stock and the customer comes into play at the end of the cycle, when the final product already exists (with a certain number of choices). If the customer gets involved before the production starts, i.e. at the beginning of the cycle, we refer to tailored manufacturing. In mass customized production the point of customer involvement is located within the production phase, which is thus split into component production (standardized product and service components, customer-independent pre-

fabrication) and combination, adjustment or special production (customer-oriented production, manufacturing on request) (Duray et al., 2000; Reichwald & Piller 2002).

The product modularity. To assemble a product from components requires a modular structure in both production and the final product. The primary objective of modularization is to avoid the excessive complexity of the production processes and thus to reduce the complexity costs (Reichwald & Piller 2002). Additionally, a higher diversity of product options can be achieved by combining modules. Consequently, modularity appears to be the key to achieving low cost customization by reducing the variety of components and offering a greater range of end products. MC requires the effective use of modular product designs (Duray et al., 2000). Compared to tailored manufacturing the choice is limited, but it is clearly wider and more flexible than in mass production, as well as favorably priced.

Several types of modularity are possible; an essential difference is where in the production cycle modularity is used. Component-sharing and cut-to-fit modularity are introduced in early stages, i.e. phase 1 and 2, design and fabrication. Component-swapping, mix, bus and sectional modularity are introduced in later stages of the production cycle, i.e. while assembling and using the final product (phase 3 and 4)(Ulrich & Tung, 1991). Depending on when the customer is involved and when modularity is introduced, MC configurations can be classified in four categories: fabricators (early customer involvement and introduction of modularity), involvers (early customer involvement, late introduction of modularity), modularizers (late customer involvement, early introduction of modularity) and assemblers (late customer involvement and introduction of modularity)(Duray et al., 2000).

1.3 Designing mass customized teaching and training

The implementation of MC in teaching and training requires a view of the production cycle as described above. The potential performance mainly consists of the training provider's expertise, possibly supplemented by pedagogic resources (e.g. teaching materials), too. After having defined the training scope together with the customer in the design phase (phase 1) the content and the pedagogy of the training are specified. Analogous to component fabrication, training preparation (phase 2) includes the production of learning materials and the development of training units. In the assembly phase (phase 3), the training units are combined to a final learning scenario consisting of the learners' interaction with the trainer, the learning materials and among the learners. Eventually, the learning scenario is realized in the phase of training delivery (phase 4). During the entire process, the learner has the role of a customer whose needs the training provider should cover by teaching and training of appropriate quality. The learner is the beneficiary of the learning offer, and – unlike the commercial provider-customer relationship – has to participate actively in the learning process and meet certain requirements (usually to have a certain amount of previous knowledge and to prove it in various tasks) to access what the units offer. From this perspective, the MC design principles established in production apply to teaching and training as follows:

1. The learner involvement

(a) The point of learner involvement. MC implies the involvement (or the integration, as Reichwald and Piller, 2002, put it) of the learner during the

preparation or assembly phase of the training (phase 2 or 3). The learner plays an active role as co-designer of the educational service (Pine & Gilmore, 2000). It is insufficient to survey the characteristics of the average learner within a group. Traditional needs assessment does not eliminate the learner's anonymity within the target group. The need for knowledge and skills has to be detected individually.

(b) The interaction with the learner. As Piller (2003) points out, it is the (training) provider's task to collect data, information and knowledge about the customer (or learner), and to deduce his or her needs. Therefore, the provider involves the customer or learner in a dialogue described as customer relationship management (CRM). This includes surveying and understanding the customer’s needs, defining a solution space of options in line with the training offer, supporting the learner in navigating in the solution space, converting the learner’s decisions into an effective process of production, and optimizing his or her preparations for future requests (Kurniawan, Tseng & So, 2003). In comparing economic and educational MC, the differences in the significance of the interaction become clear. In economic MC, interaction with the customer is usually a limited instrument, so it is minimized as far as possible. The educational interaction is a self-contained objective and is given particular attention, especially within the teaching and training design.

The interaction between training provider and learner can be either explicit, for example, consisting of simple questioning, or implicit, by observing the learners' navigation in the solution space (Risch & Schubert, 2005). However, the process of interaction within the scope of a product customization challenges the customer organization as well as the learner, who possibly does not have a concrete idea about the final product (Zipkin, 2001). A certain amount of expertise is required,

which may result into in customers' (Kurniawan et al., 2003) or learners' cognitive overload.

(c) The learner profile. From the interaction between provider and customer, a customer or learner profile emerges, which serves as a basis for further negotiations. Traditionally, experienced teachers know their students thoroughly, and adapt their teaching to the students' characteristics. Many applications of technology-enhanced learning use explicit learner profiles (e.g. Brown, Cristea, Stewart & Brailsford, 2005; Conlan, 2005; Gabriel et al., 2007), which are clearly recommendable within the scope of long-term relationships between an e-learning provider and a high number of learners. Learner profiles may include information about learner's characteristics, knowledge and skills. Additionally, for teaching and training in organizations workplace prerequisites are highly relevant and must be included in the learners' profile as individual learning goals.

2. The training modularity. Modular structures are ubiquitous in formal learning. For example in schools, timetables are grids indicating sequences of modules with standard length and a given number of subjects. However, pupils have limited freedom in choosing individual subjects (Waslander, 2007). In higher education, the curriculum can be customized to a higher degree by choosing optional courses or even by students' changing universities by taking part in international academic cooperation programs. For e-learning, modularization is technologically provided by the design of standardized formats and interfaces, and by reusable learning objects. A customizable learning design can be built up by choosing various modules and combining them to form a complete learning environment (Gabriel et al., 2007). Based on the MC classification adopted by Duray and colleagues (2000), we may

notice that since information is getting rapidly out of date and the workplace requirements are changing more frequently, training modules must be created new or get updated quite regularly. Therefore both customer involvement and modularity are located mainly in the first two phases of the training production cycle (Phases 1+2). Hence, component-sharing and cut-to-fit modularity will be prevalent, and MC configurations in teaching and training will probably correspond in the majority of cases to the type ‘fabricator’ (early customer involvement and modularity, as opposed to ‘assembler’, i.e. late customer involvement and modularity, ‘modularizer’, i.e. late customer involvement and early modularity, or ‘involver’, i.e. early customer involvement and late modularity)(Duray et al., 2000).

Which effects can be expected from mass customized teaching and training? As its proponents (Fried, 2008; Gabriel et al., 2007; Mulder, 2005; Waslander, 2007) argue, MC has the same advantages for education as for the economy. Referring to the ‘customization’ part, mass customized teaching and training should widely cover individual needs of knowledge and skills. In regard of the ‘mass’ part, delivering MC teaching and training to a large number of learners should lead to economies of scale, i.e. limit the training production costs for a bigger numbers of participants. Learning effects on the trainers’ side may also contribute to limiting training production costs. However, there are very few examples and studies about MC in education (Gabriel et al., 2007; Waslander, 2007; Williams & Mistree, 2006), and even less empirical evidence for its advantages.

1.4 The role of technology in mass customized teaching and training

Which role does the technology play in a MC training? The answer to this question becomes clear by observing reports on customizing teaching in large educational institutions such as, for example, the Dutch vocational schools (Waslander, 2007). Here, implementation strategies can be divided into two distinct areas, the managerial-didactic frame for mass-customization and the use of technological tools. The former is mainly conceptual and includes a macro-didactic concept as well as related measures like choosing appropriate scenarios and units of organization, reducing the learners' heterogeneity, or providing specific resources. The latter is primarily technical and consists of modularizing learning, digitizing learning material, and using computer-based learning and testing. It is the managerial-didactic frame that determines the goals, scope, and application context of technology. Technology, on the other hand, responds with quick operations, which is of great advantage, particularly with very large learner populations. As Pine (1993) emphasizes, "anything that can be digitized can be customized" – even quicker with computers, we may add. However, technology is not essential for mass customized learning. Several examples (e.g. Waslander 2007; Williams & Mistree 2006) show interesting and successful computer-free alternatives.

2 amit™ – a framework for mass customized training

Against the background of the MC design principles discussed, the following section presents amit™ as a framework for mass customized training in medium-sized and large organizations. The example is provided as a work-in-progress. The first step of the development is described in this paper and consists of the conception and development of the MC framework. This is based mainly on human activity. Future work will rely on the experience of using this and will progressively replace human teaching activity by advanced learning technology.

2.1 Goals and constraints

amit™ (German acronym for 'workplace-oriented modular customized training') is a frame for mass-customized training in large organizations and companies. The learning goal of the two amit™ applications presented below was to train software skills related to newly introduced versions of office and communication software. The learners were already experienced and used to work with previous versions of the training software. A major design constraint was that training took place immediately after new software versions were released; therefore no suitable training material was available at that time. It had to be authored in a short time during the ongoing learning activity.

The amit™ prototype studied here was requested by two customer organizations, which aimed to reduce the gap between the workplace requirements and the individual, computer related knowledge and skills of their staff. Another important

goal was to save learner's time and effort by concentrating training on individually relevant topics. Economically, the development process of amit™ aimed at keeping the employed manpower of the training provider constant, as far as possible. Concerning the use of technology, one customer requested a half e-learning half face-to-face learning concept, whereas the other wanted to work with face-to-face training, only.

2.2 The amit™ scenario

The most important aspect of amit™ is the customer relations management feature (CRM), within which the individual needs of the learners are analyzed and thus the topics selected (i.e. reducing all the topics related to office and communication software to those needed at all the workplaces of the company), for which training material has to be developed. The potential of the training provider consisted in software related expertise owned by available trainers who were able to cover the topics related to office and communication software. Virtually, the complete curriculum of the software trainings covered all the functions and applications of the office software. A collection of training materials used in the past was available. These described older versions of the software, and could be updated to match the new version.

The CRM was carried out during phases 1 and 2 of the production cycle, i.e. during training design and preparation (fig. 1). The aim of the interaction was to elicit the individual needs of knowledge and skills while selecting the training content. This was done in the following three steps (fig. 2):

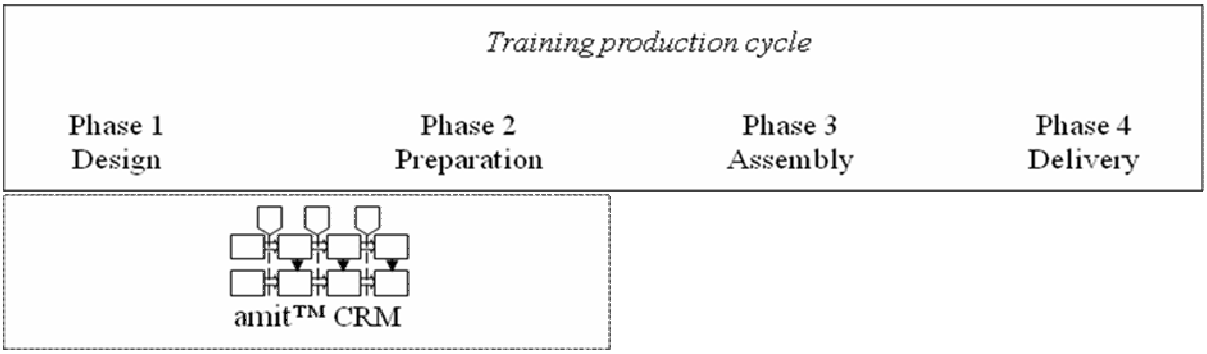

Fig. 1: amit™: The position of CRM in the context of the training production cycle

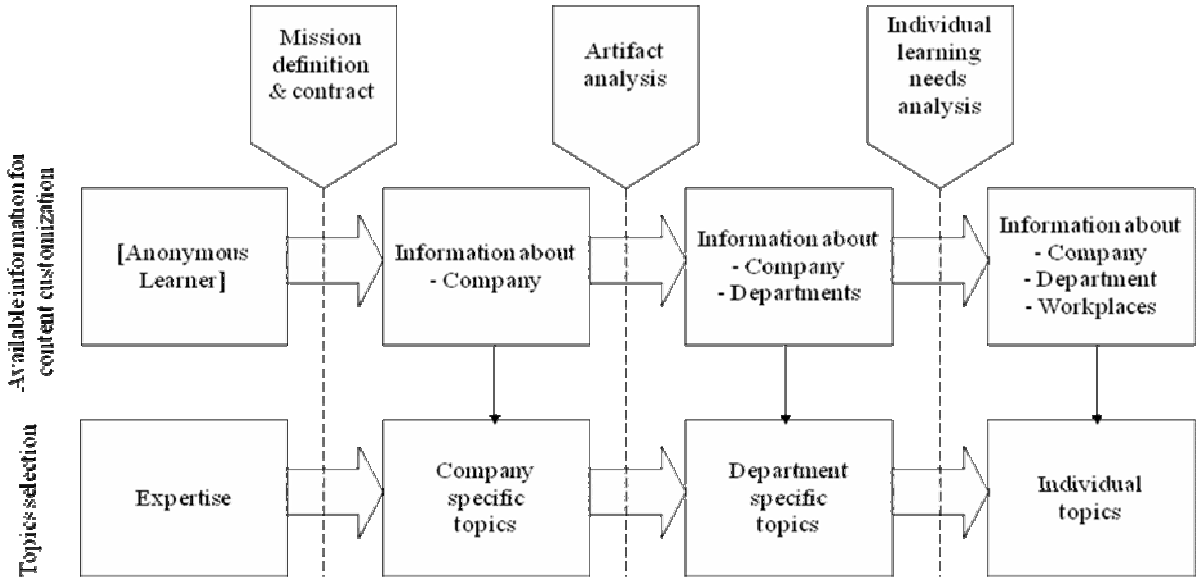

Fig. 2: CRM: Topics selection and available information for content customization

1. **Mission definition and contract**. After the training provider came into contact with the customer organizations, they agreed on the scope of the training and secured the training contract. According to this, the training provider began to engage appropriate trainers. First, an individual curriculum

for each customer organization was developed. These curricula were a subset of the general software training curriculum.

2. **Artifact analysis**. As a second step the trainers collected and analyzed the artifacts (i.e. letters, text templates, data tables and presentations etc.) that were frequently handled in the departments involved in the software training and with which the staff had to work. This analysis resulted in a list of topics describing the knowledge needs of the learners. Thus, the company specific curriculum was further reduced.

3. **Individual learning needs analysis**. In each department, the trainers had short individual discussions with learners in order to compare the workplace requirements with learners' individual knowledge and interests. The discussions resulted in individual learning plans. This reduced the curriculum once more. The trainers defined learner profiles and gave each participant an individual training plan (an example is given in tab. 1), consisting of a list of training modules that he or she had to complete.

Table 1: An example of content selection for the individual training program

Company specific topics	Knowledge needs after artifact analysis	Knowledge needs after individual testing
Module 1: Working with spreadsheets (basic level)	✓	–
Module 2: Advanced spreadsheet editing	✓	✓
Module 3: Embedding graphics and objects	–	
Module 4: Text templates	–	
Module 5: Team work on text documents	✓	✓
Module 6: Structuring text documents	–	
Module 7: Tables of contents	✓	–
…	…	…

According to the reduced curriculum, the trainers could now start phase 2, i.e. the development of the training modules. They began with the topics that were needed the most, and used either available, older versions of the training material and adapted it to the actual software version, or they started from the scratch and created new material.

The definition of the training modules is based on frequent operations, which the learners usually have to perform using the trained software (e.g. editing tables, embedding graphics or using templates with a text editor). In a training module, one complex operation was explained in detail as a sequence of elementary operations (e.g. highlighting a table column and choosing a format by clicking on icons). It was completed with hints on aspects that should be considered and warnings about possible mistakes. Additionally, the theory alternated with examples collected in the departments and with exercises. The size of a training module was limited to a maximum training time of approx. 40 min. More complex topics that required more time were split into parts of the same length.

Ideally, each module should be provided in a face-to-face and an electronic learning version. However, the amit™ implementation aimed to reduce costs. Hence, the topics with a lower degree of difficulty (e.g. older or well-known features of the trained software) were preferred to be implemented as e-learning. Totally new features or features that had changed a lot compared to the older version were estimated to have a higher degree of difficulty. For these, the trainers preferred face-to-face teaching modules; their implementation as e-learning was left for later.

As soon as the learning material was developed, training could start. The learners

were notified when and where the face-to-face training modules were held. The e-learning modules were uploaded on a server and the access data were communicated to the learners. In both cases, each learner took part in all the training modules specified in his or her individual training plan. This corresponds to the phases 3 and 4, i.e. assembly and delivery of the training production cycle.

2.3 Analysis of the MC design

The claim that amit™ is mass customized training must be sustained by analysing in what way and to what degree amit is in accordance with the MC design principles presented above. The application of these principles is discussed in the following.

1. The learner involvement.

(a) The point of learner involvement. The crucial point in the didactic concept of amit™ is the learner's involvement, realized by producing the training contents after contact with the customers and learners. As a shortcoming, amit™ induces moderate learner activity, i.e. similarly to other mass customized learning environments (e.g. Gabriel et al., 2007) the learners have only to “consume” the provided resources. Increasing the learner activity may imply learner-generated content such as in blogs or wikis. The question is however how much the learners in companies and organizations would accept and whether they would have time for more activity in the long run.

(b) The interaction with the learner. The amit™ CRM consists of interaction with the customer organization on three levels, from the organization as a whole

represented by the human resources manager, to the individual staff members. Assuming that the goals and tasks of the individual workers are integrated in the objectives of the organization, the amit™ CRM appears as a zoom-in process that efficiently elicits the individual knowledge and skills necessary to carry out the tasks in the organization in its various dimensions. The solution space integrates the complete curriculum for office and communication software. By analyzing the artifacts, the amit™ trainers observe the learners while navigating in this space.

(c) The learner profile. The elicitation process of the workplace requirements and learners' knowledge and skills iteratively leads to individual learning profiles. Since this is personal information, particular caution must be taken with data privacy and security (Risch & Schubert, 2005). amit™ uses individual training programs that contain implicit information about the learners. These are handed to the learners. The trainers do not need any copy of them. Within the scope of this training, such a solution was adequate and practicable. Nevertheless more flexible learner profiles may be necessary in the longer term. For these, the use of technology would be indispensable, e.g. a learning management system.

2. The training modularity. The amit™ scenario requires and supports a modular content structure. Relying on Duray et al. (2000), both the point of customer involvement and the type of modularity (component-sharing or cut-to-fit modularity) are positioned in the phase 1 and 2 of the training production cycle. The MC configuration thus corresponds to the type "fabricators". The training material is reusable not only due to its modular format, but also from the perspective of long-term content development. In the described training, new content was developed; later, it may be reused, i.e. delivered to other organizations or further developed. The

modularity and reusability of the training materials facilitate the technology use.

As for the role of technology, in the present form the computer support was kept to a minimum or completely avoided. However the present study may convince the trainers and their customers to take advantage of technology and enhance thus the efficiency of the amit™ training in the future. Besides the electronic management of learning materials and learner profiles, the use of learner-generated content may also increase training efficiency. Expert learners may be quick at finding and understanding the new software features, and may also be motivated to share their knowledge with colleagues by contributing to the content development, as suggested above.

2.4 First prototype evaluation

Setting and method. The first amit™ training was conducted in a project of continuing education for employees of a large, local public administration with a total of approx. 16,000 employees. The scope of the training was the familiarization of the staff with a newly released version of an office software package consisting of a text editor and a spreadsheet calculation program. After defining the mission of the training, the amit™ trainers formulated a curriculum including 13 training modules for the text editor and 15 for the spreadsheet calculation software. The analysis of the workplace requirements allowed for the reduction of the number of modules as shown in table 2. The individual training programs contained between 2 and 5 modules on the text editing topics and under 4 modules for spreadsheet calculation topics. Then the training content was developed accordingly and training was

delivered on-the-job, face-to-face and via e-learning, in one week by one trainer to fourteen employees. At the end of the training period, the participants were asked to answer a short evaluation questionnaire; items 1 and 2 were related to learners' acceptance of the amit™ training, items 3-5 asked them to rate the training customization. The items 6-8 were aimed at evaluating the knowledge and skill acquisition. 13 of the 14 participants responded; the **results** are presented in table 3.

Discussion. In summary, the first evaluation results were positive and encouraging. The workplace requirement analysis combined with content modularization reduced the development effort to approximately one third. After the training period, the learning materials remained available for further use, which may reduce the production costs of the training provider in the long term. The learners expressed high acceptance of the customized training, they mostly could coordinate the training with their work schedule and they found the amit™ training helpful for updating their software knowledge and skills. Through the high response rate the collected data is representative for the participant population – which is however very small, as compared to the size of the organization. The lack of more detailed data on the cognitive effects was due to research restrictions imposed by the data privacy policy of the public administration, which restrained the internal validity. The external validity may be generally high in field studies; in this case it is limited by the small sample size. Also, the sample is not yet representative for "mass" customization. Therefore, more valid evaluation results are expected from a further study on a larger sample.

Table 2: Module selection and reduction for the first amit™ training

Total number of training modules after the…	Text editor	Spreadsheet calculation software
…mission definition and contract	13	15
…artifact analysis	8	9
…individual learning analysis	5	4

Table 3: Evaluation of the first amit™ prototype: questionnaire items and response distribution

	Questionnaire item	N	M	SD	strongly agree 1	agree 2	neutral 3	disagree 4	strongly disagree 5
	Acceptance items								
1	I liked the amit™ training.	13	1.69	1.03	8	2	2	1	0
2	I liked to have my own, individual training contents.	13	1.00	0.00	13	0	0	0	0
	Rating of the training customization								
3	The learning materials were closely related to my workplace requirements.	13	2.00	0.91	5	3	5	0	0
4	The tasks and exercises were closely related to my workplace requirements.	13	2.00	0.91	5	3	5	0	0
5	The training schedule was easy to coordinate with my work.	13	2.08	1.19	6	2	3	2	0
	Learning effects								
6	My participation in the amit™ training helped me to update my knowledge and skills related to office software.	13	1.46	0.78	9	2	2	0	0
7	amit™ helped me to find out everything I wanted to know about the office software.	13	2.38	1.19	4	3	3	3	0
8	I can apply the knowledge I acquired in the amit™ training at my workplace.	13	1.92	0.86	4	7	1	1	0

2.5 Second prototype evaluation

Setting and method. The second amit™ training was conducted in a similar project of continuing education at a medium-sized company that produces baby nutrition. Again, the scope of the training was the familiarization of the staff with a newly released version of an office software package including a text editor, a spreadsheet

calculation program, presentation software and an e-mail client. The initial curriculum contained 13 training modules on text editing, 15 modules on spreadsheet calculation, 11 modules on presentation software, and 14 modules on e-mail client topics. These could be reduced to 11, 14, 8 and respectively 11 modules as shown in table 4. The individual training plans included a maximum of 4 modules on text editing, 11 modules on spreadsheet calculation, 5 modules on presentation software, and 6 modules on e-mail client topics. Accordingly, the training modules were developed partially from scratch, partially by adapting previous material. The authors were 2 trainers of the training provider.

Table 4: Module selection and reduction for the second amit™ training

Total number of training modules after the…	Text editor	Spreadsheet calculation software	Presentation software	E-mail client
…mission definition and contract	13	15	11	14
…artifact analysis	12	14	9	14
…individual learning analysis	11	14	8	11

The amit™ training was delivered face-to-face by 5 trainers (2 from the training provider, 3 from the customer company) during a period of 11 months; the training duration was limited to 2 weeks pro person. There were 456 participants, 296 female and 160 male staff members aged between 17 and 55. One month after the end of the entire training period, a paper-and-pencil survey (Table 5) was run, which contained 5 acceptance items, 3 items on customization and 5 on learning effects. 64 participants, i.e. 40 females and 22 males (additionally 2 who did not specify their gender) responded. In this case, too, the research questions were restricted by the data privacy policy of the company. No test items evaluating individual competence were allowed. To grasp the cognitive effects of the training, the questionnaire data

were complemented by interviews with the IT helpdesk (1 female and 2 males, aged between 25 and 30), with the heads of the involved departments (2 females and 2 males, aged between 35 and 40), with the human resource manager of the customer company (male, aged between 35 and 40), and finally with the trainers belonging to the training provider (2 females, aged between 35 and 40).

Table 5: Evaluation of the second amit™ prototype: questionnaire items and response distribution

	Questionnaire item	N	M	SD	strongly agree 1	agree 2	neutral 3	disagree 4	strongly disagree 5
	Acceptance items								
1	I liked the amit™ training.	64	1.63	0.70	32	24	8	0	0
2	I liked to have my own, individual training contents.	63	1.78	1.04	35	13	10	4	1
3	I appreciated the training concentrating on the really necessary contents.	64	1.70	0.71	27	30	6	1	0
4	In the future, I would like to participate in similar training sessions.	63	1.44	0.74	44	10	9	0	0
5	For the amit™ training I needed less time than with previous training methods.	58	1.84	0.70	18	32	7	1	0
	Rating of the training customization								
6	The learning materials were closely related to my workplace requirements.	63	2.06	0.75	16	27	20	0	0
7	The tasks and exercises were closely relates to my workplace requirements.	57	2.14	0.71	10	30	16	1	0
8	The training schedule was easy to coordinate with my work.	57	1.90	0.81	20	26	9	2	0
	Learning effect								
9	My participation in the amit™ training helped me to update my knowledge and skills related to office software.	58	1.38	0.62	40	14	4	0	0

10	amit™ helped me to find out everything I wanted to know about office software.	58	1.97	0.65	12	37	8	1	0
11	I can apply the knowledge I acquired in the amit™ training at my workplace.	58	1.93	0.65	13	37	7	1	0
12	The solutions I learned in the amit™ training match my workplace tasks.	58	1.86	0.74	19	29	9	1	0
13	The knowledge and skills I acquired in the amit™ training help me to work more efficiently.	58	1.84	0.70	18	32	7	1	0

Results. The summative evaluation results (Table 5) were mostly positive. The acceptance of the customized training was high among most of the participants' sample. Many of them had saved time with amit™ compared to previous training methods. Moreover, most participants confirmed that their individual training plan matched their workplace requirements. Besides a few exceptions, they could coordinate their training schedules with their work. The majority of the participants' sample could apply the knowledge and skills acquired in the training to their work. These results were consistent with the impressions of the heads of the involved departments, who had analysed various products and artefacts related to the training, and noticed improved quality. They interpreted this change as a positive indicator of the amit™ training efficacy. No effect could be observed by the IT helpdesk staff. According to their statistics, the number of calls and the quality of the questions asked by the callers had not changed. They remarked however that the callers had not taken part in the amit™ training, and pointed at a desirable but missing coordination between the helpdesk caller statistics and the contents of the amit™ training.

From a different point of view, the trainers compared amit™ with previous training methods and found it to require more effort for preparing, developing and delivering, and especially for eliciting the individual needs of knowledge and skills. While delivering the training, they felt stressed due to the tight schedule that had to be met. Another difficulty was permanent changes among the participant groups. On the other hand, participant groups were more homogenous, which made training easier for everybody. Furthermore, both trainers believed that the total time and effort necessary for repeating amit™ with the same topics would be much smaller since they would be familiar with the training method, and could reuse most of the produced materials.

Regarding the workplace organization in the customer company, the human resources manager found the face-to-face training to be unnecessarily time-consuming and expensive, and proposed to implement e-learning for future training on-the-job. Additionally, he remarked that the trained software was installed after the completion of the training period of 11 months. Thus an important part of the staff were not able to apply the trained knowledge immediately after the training.

Discussion. The second amit™ evaluation was positive and encouraging, too. The customized training was successfully delivered to a significantly larger participant population that accepted it to a high degree. The main acceptance factor was the customization that covered individual knowledge needs and thus saved participants' time. The customized training was regarded as being closely related to the participants' individual workplace requirements, which was a main objective of the training. The learners could update their knowledge of the trained software and apply it at their workplace. This possibility was however limited for several participants on

account of the delayed roll out of the trained software.

However the setting including a large participant population revealed two core issues. First, the number of training modules could no longer be reduced as far as in the first amit™ prototype, which is certainly due to the greater number of participants and therefore to the higher diversity of learning needs and prerequisites. Nevertheless, in the second amit™ prototype the participant group was over 30 times larger, while the number of training modules was about double, which indicates an important economy of scale. The learning effect on the trainers' side has probably contributed to this, too. At the same time, the learning effect is a possible explanation for the unexpectedly small reduction in topics; perhaps, the trainers had anticipated individual training needs better in the second prototype than in the first. The second issue was that face-to-face mass customized training turned out to be laborious and stressful for the trainers. This effect is expected to decrease with the trainers gaining experience, and with the implementation of the technology as a learning management system or as e-learning.

The internal validity of the evaluation results was improved by the larger participant population; the sample of 64 survey respondents from the total of 456 training participants was however small. The external validity of the field study can be, again, regarded as high, due to the field setting. Limitations result from the lack of more detailed data on the cognitive effects, which was restricted by the data privacy policy.

3 Conclusions and future work

In conclusion, amit™ was successfully delivered as mass customized training to

a total population of approx. 500 learners. This was based on new and customized software training materials that kept account of individual workplace requests. The training saved resources and especially the participants' time by focussing on individually relevant topics. Therefore, the learners accepted the amit™ training. For the first prototype, with a small participant population, the number of training modules and thus the development effort could be reduced to approximately one third. For the second prototype, with a significantly larger participant population, the topic reduction was minimal; nevertheless, amit™ enabled an important economy of scale. Also, the homogenous learner groups considerably reduced the training delivery effort, which is consistent to Waslander's (2007) findings.

A particular issue was the effort of preparing and delivering the training from trainers' point of view. This is probably a characteristic of the introduction phase that is expected to decrease in the future. On the one hand, delivering the training is not expected to require more efforts than traditional training after the trainers gained routine. On the other hand, the content development for amit™ contributed significantly to extend the available learning material, therefore the development effort is also expected to decrease for future application. Finally, the introduction of e-learning appears as a very recommendable option.

Another issue regards the organizational context. The organizations seem to be insufficiently prepared for the MC concept. The new software was first trained, and then rolled out. This may appear to be organizationally reasonable. From a pedagogically point of view it is merely questionable if learners haven't got the immediate possibility to apply the newly acquired knowledge after the training. As Pine, Victor and Boynton (1993) observe, "not just an extension of continuous

improvement, mass customization calls for a transformed company". In this sense, mass customized teaching and training requires also changes in the learning culture of the organization.

To sum up, the evaluation results obtained until now encourage the further development and use of amit™ in the practice of continuing education, while optimizing some of its components and features. First of all, an extended use of technology appears to be suitable. The administration of the learners and learning modules can be supported by the use of learning management systems. The same platform should include a model of the known knowledge domain, with the possibility of observing and testing the users, and thus keeping track of the learner profiles (Conlan, 2005, p. 26). A configurator (Kurniawan et al., 2003) can accompany the learner during the process of customization and learning. The use of learner-generated content appears recommendable, too.

From the educational research perspective, further research is necessary. An important question for future research may be which characteristics of the learner – besides knowledge and skills – are relevant for the learning goals and how these are to be surveyed. Also, the learning performance and effort should be measured more precisely by using more reliable instruments, which may also require further laboratory study.

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