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| 总序号 | **92** | 姓名 | 朱付鄂 | 班级 | 艺设173班  | 学号 |  1049731703966 |
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**专业英语**

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| **题目** | Toward Developing a Design Method of Personalization:Proposal of a Personalization Procedure；Understanding Design Methods - Using Explanatory Videos for KnowledgeTransfer in Engineering Disciplines |
| **学院** | 艺术与设计学院 |
| **专业** | 艺术设计 |
| **班级** | 艺设173 |
| **姓名** | 朱付鄂 |
| **指导教师** | 王美艳 |
| **课程分数** |  |
| **教师签名** |  |

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Toward Developing a Design Method of Personalization:

Proposal of a Personalization Procedure

个性化设计方法的发展：个性化流程的提案

**Abstract:**

Personalization of products and services is promising not only to enhance customer satisfaction but also to realize sustainable consumption and production. An obstacle in personalizing more products and services is the lack of instruction for designers working on personalization. Our research objective is to develop design methodology to realize personalization for supporting providers of personalization. First, this paper starts with the analysis of the process of personalization and suggest that there are various procedures for creating personalized products and services and to design procedure is the key for personalization design. Then, this paper proposes two conceptual levels and design process of personalization. This paper finally examines this methodology through a case study.

**内容摘要:**

产品和服务的个性化不但可以提高顾客满意度，而且可以实现可持续消费和生产。个性化更多的产品和服务存在的一个障碍是缺乏对设计师个性化的指导。我们的研究目标是开发设计方法，以实现个性化服务提供者的个性化。本文首先对个性化的过程进行了分析，提出了个性化产品和服务的创建有多种流程，设计过程是个性化设计的关键。然后，本文提出了个性化设计的两个概念层次和设计过程。本文最后通过案例研究对这一方法进行了检验。

**Key words:**

Personalization; Design Method; Product Service System; Sustainable Consumption and Prodcuction;

**关键词:**

个性化；设计方法；产品服务体系；可持续消费与生产；

## 1. Introduction

## **1.介绍**

The importance of personalization in the design of products and services has been emphasized for a long time [1]. The conventional argument for the demands of personalization is that it is necessary to diversify the functions and features of products and services to satisfy more customers who have different needs. This claim came from the recognition that the paradigm of the manufacturing industry has changed from mass production to mass customization [2]. Progress in information technology and production technology encourage the realization of personalization [3].

长期以来，产品和服务设计一直在强调个性化的重要性。[1]个性化需求的传统观点认为，为了迎合更多用户的不同需求，使产品的功能和特性呈现多样化是必不可少的。这种说法来源于制造业从大规模形式的生产转化为大规模定制上的认识。[2]信息技术与生产技术的发展促使了个性化的实现。[3]

In addition to these arguments, the importance of personalization towards sustainable consumption and production has begun to be pointed out [4]. To improve the efficiency of the resource and energy use, it is necessary to prolong the period of use of the product and to provide value to customers by services with less resource usage. One means of achieving these objectives is to manage the compatibility of products and services with individuals throughout the life cycle. Personalization has the potential to contribute to life cycle engineering for sustainability.

除了这些观点之外，目前已开始强调个性化对可持续消费和生产的重要性。[4]为了提高资源和能源的使用效率，有必要延长产品的使用周期，并通过提供给消耗较少资源的服务给客户带来价值。实现这些目标的一种途径是，在整个产品生命周期内管理好产品和服务与个人的协调性。个性化有助于生命周期工程的可持续性。

An obstacle in personalizing more products and services is the lack of instruction for designers working on personalization.It is difficult to design personalization appropriately to improve the satisfaction level and extend the use period [5].Furthermore, despite the many efforts of personalization, few researchers compare them or discuss a general property.

在个性化更多产品和服务过程中存在的一个障碍是在个性化设计工作中缺乏对设计师的指导。设计个性化时，适当的提高满意度级别和延长使用期是比较困难的。[5]除此之外，尽管研究人员对于研究个性化付出了很大的努力，很少有研究者就个性化的一般性质进行比较或讨论。

Our research objective is to establish a methodology for personalization design of products and services to support designers. As a first step, this paper proposes the concept of“design procedure” for personalization .The rest of this paper is organized as follows. Section 2 introduces the concept of personalization design and related research. Section 3 explains the personalization design procedure with case examples. Section 4 proposes a framework on how to design the procedure and conducts a case study.

我们的研究目的是建立一个产品和服务个性化设计方法来支持设计师。作为第一步，本篇论文提出了个性化设计“设计方案”的概念。剩余的部分则是如下安排。第二部分介绍了个性化设计和相关研究的概念。第三节用案例说明了个性化设计的设计过程。第四节提出了如何设计程序和进行案例研究的框架。

## **Personalization design**

## **个性化设计**

#### *2.1. Personalization*

#### *2.1个性化*

Despite numerous cases and research efforts on personalization, there is no general definition of personalization [6]. We here recognize personalization as “to give characteristics correspond to a person to an object”. The objects are usually artifacts. The given characteristics include aesthetic attributes such as appearance as well as functions and behaviors.

尽管在个性化方面进行了大量的案例尝试及研究，没有关于个性化的任何一般性的定义。[6]

我们在这里将个性化视为“赋予对应个人的特征于某一事物上”。对象通常为人造物体。给定的特征包括美学属性，例如外观以及功能与行为。

The most basic personalization is to write the name or affiliation on a product to identify its owner. Other examples are such as to tailor a cloth that fit someone's body shape and to make furniture of favorite color and shape. Each personalization refers certain properties of a person such as physical characteristics (e.g., height, weight), mental characteristics (e.g., preference, personality), identification (e.g., name, affiliation) and a surrounding environment (e.g.,related people). These properties and their configurations are different from each other.

最基本的个性化是在产品上写下名字或附属关系去识别它的所有者。除此之外， 例如裁剪布料去适合某人的身材和制作采用用户喜欢颜色和形状的家具。每个个性化要素都涉及一个人的特定性质，例如，身体特征（如身高、体重），精神特征（如偏好、性格），身份（如姓名、关系）和周围环境（如相关联的人）。这些性质和它们的配置是彼此不同的。

#### ***2.2. Personalization design***

#### ***2.2个性化设计***

In order to realize personalization, it is essential to design products and services suited to individuals. We define “personalization design”as a design activity to realize personalization of products and services. Personalization design provides products and services that have functions and features correspond to the capabilities and preferences of the person. For example, making artificial leg requires body measurement to fit it personally. Choosing optional modules in car dealer realizes interior and exterior which is preferable for the individual customer. Recommendation on web shop realizes unexpected encounter for customers with desired products. Personalization design is an extension of traditional design. In the traditional design, the specification that the product or service should accomplish is left to the judgment of the designer. In the personalization design, the specification should be changed according to the individual customer. In order to realize such procedures, sometimes designers interact with customers. Fig. 1 shows the conceptual diagram of personalization design. A person has its own physical and mental characteristics and surrounding situation that include products, services and related people. Personalization provider does not control the person and the surrounding situations but gets information from them. The personalization provider uses this information and designs and produces products and services suited for the person. The person can judge its function or feature and feedback it to the personalization provider.

为了实现个性化，设计适合个人的产品和服务十分重要。我们将个性化设计定义为去实现产品和服务的个性化的设计活动。个性化设计提供了具有与人能力和偏好相对应的功能及特征的产品和服务。例如，制造假腿时需要人体测量来适合个人的身材。在汽车经销商购车环节可选择汽车的内部和外部模块让独立顾客更加青睐。网上商城的推荐功能实现了带有期望商品需求客户的意外邂逅。个性化设计是传统设计的延伸。在传统设计中，完成的产品和服务规格由设计师的判断决定。在个性设计中，产品的规格应该根据客户个人改变。为了实现这样的程序，有时设计师和用户之间会产生交互。图1显示了个性化设计的概念图。个人有他自身身体和心理上特征和包含产品、服务、关联人群的周围环境。个性化的提供者不去控制个人和他所在的环境，而是从他们身上获取信息。个性化的提供者使用这些信息去进行设计、去生产产品、提供服务来满足个人。个人可以判断他的功能或特征并向个性化的提供者反馈。

We note that personalization provider is not always a business operator. In some cases such as producing furniture by self, customers play a role of personalization provider and produce personalized products and services by themselves. In other cases such as a recommendation on web shop, the product itself plays personalization provider with any systematic algorithm and automatically change its own function or behavior.

我们注意到个性化的提供者不总是一个商业运营者。在某些情况下，如自己制作家具，客户既扮演了个性化的提供者也自己产生了个性化的产品和服务。在其他一些情况下，如网上商店的推荐。通过某些系统算法，商品自身扮演了个性化的提供者，并且自动改变其自身的功能和行为。





#### ***2.3. Related research***

#### ***2.3相关研究***

##### 2.3.1. Participatory design and production

#### ***2.3.1 参与式的设计和生产***

A popular proposal about design for personalization is to involve users to design and production process. There are various approaches for it. For example, Koren et al. Proposed open-platform products for which customers can combine products or modules from different companies [7]. Zine et al. constructed a framework with co-design and co-creation leads to personalization [8]. Tan et al. show their scheme to use cyber physical system and digital design tool with 3D models for enabling personalization [9]. Participatory approaches introduce customer’s intention and hign customer satisfaction.

关于个性化的一个流行的建议是让用户参与设计与制作的的流程。这里有各种各样的方法。例如，Koren等人提出了开放平台形式的产品，客户可以结合来源于不同公司的产品或者模块。Tan等人展示他们的计划，通过使用网络物理系统和依靠3D模型技术支持的数字设计工具使个性化成为可能。

##### **2.3.2. User modeling and adaptation**

#### ***2.3.2 用户建模和同化***

Another approach to realize personalization uses the technique of user modeling in which customers’s need could be identified and the content could be adapted to suit those needs[10]. Probably the most popular work on personalization in this field is a personalized search by Google or recommendation in Amazon website. Technologies for user modeling are still enthusiastically studied in information and computational science, especially on the internet technology [11], and have a large impact on marketing [12]. With the support of computers, user modeling and adaptation approach help customers get the desired information and bring unexpected encounters with wonderful products.

实现个性化的另外一种途径是使用用户建模技术，在使用这种技术的条件下，顾客的需求可以被识别，并且内容可以适应这些需要。[10]该领域中个性化最受欢迎的作品是谷歌出品的个性化搜索和亚马逊网站上的推荐。[11]用户建模技术仍然在信息和计算被研究，尤其是在互联网技术方面，并且对营销产生了巨大的影响。[12]在计算机技术的支持下，用户建模和同化方法可帮助客户获取所需的信息，带来意想不到的美妙产品。

#### ***2.4. Significance of personalization for life cycle engineering***

#### ***2.4个性化对生命工程周期的意义***

The main objective of Life Cycle Engineering (LCE) is to greatly reduce the use of raw materials and the impact on theexternal environment to realize sustainable society and manufacturing industry [13]. Personalization contributes to implementing LCE through in-depth analysis of the interaction between products, services, and consumers.

From the viewpoint of LCE, personalization has fourimportant features as follows:

生命周期工程（LCE）的主要目标是大大减少原材料的使用和对外部环境的影响，去实现可持续化的社会及制造业。[13]通过深度的分析产品、服务和消费者之间的交互，个性化有助于生命周期工程的实施。

从生命工程周期的角度来看，个性化具有以下四个重要的特征：

1. Personalization prevents demand and supply mismatch at the early stage of product development and suppresses excessive production [14].

2. Personalization helps customers to feel an increased attachment to the product, which results in extending product lifetimes and reducing environmental impact [15].

3. Personalization expands the market for eco-friendly business through adjusting its weightings for functionalityand environmental performance for each customer [16,17].

4. Personalization raises the awareness of the individuals for their environmental impact through the experience of designing their own consuming behavior [18].

1.个性化可以防止产品开发初期时需求和供给的不匹配，并抑制过度生产。[14]

2.个性化可以帮助客户去加深对产品的依恋感受，从而延长产品的使用寿命从而减少对环境的影响。[15]

3.个性化通过调整功能权重和顾客的环境性能来扩展环保业务的市场。[16][17]

4.个性化通过设计自己的消费行为的经验提高了个人对环境影响的认识。[18]

Personalization has the potential to improve the environmental performance of a product life cycle in the use phase in the form of product service system (PSS), which enables to provide personalized services to consumers. PSS is a promising concept to enhance competitiveness and to foster sustainability simultaneously [19]. Tukker et al. proposed the production-consumption chain that improves the environmental performance of an economic system. In that chain, personalization works from the middle to consumption side and plays roles such as intensifying use and promoting immaterial consumption [20].

个性化可以通过产品服务系统（PSS）的形式在使用阶段改善产品生命周期中的环境性能，从而为消费者提供个性化服务。产品服务系统是一个提高竞争能力并且促进可持续的有前途的概念。[19]Tukker等人提出改善经济体系环境性能的生产-消费链。在则个链条的作用下，个性化从中心向消费方面发挥作用，同时扮演着强化使用和促进非物质消费的角色。[20]

One of the challenges related to personalization is discovering ways to expand and control the scale of personalization provision. In the perspective of sustainability,Steffen et al. claimed that human should control its environmental impact not to exceed the absolute biophysical threshold called "Planetary boundary" [21]. As a business as well, previous research efforts pointed out that it is essential to provide personalization to more customers [6,12]. To achieve them the design methodology that enables to personalize more products and services for more people.

与个性化相关的挑战之一是发现扩大和控制个性化规模的途径。从可持续的角度出发，Steffen等人称人类需要控制环境的影响不超过“行星边界”的绝对生物物理阈值。[21]作为一个企业，以前的研究工作指出，为更多的客户提供个性化是至关重要的[6][12]。实现设计方法以便为更多人提供更多个性化的产品和服务。

## **3.Personalization steps and procedure**

#### **3.个性化步骤和程序**

#### ***3.1. Analysis of personalization process***

#### ***3.1个性化过程分析***

As a starting point of this research, we defined personalization design steps as a model of the general process of personalization design. It is based on the working steps of the design engineering in [23]. In actual cases, it is not always possible to divide the process clearly. But the steps help us to understand the outline of personalization design.

作为本研究的起点，我们将个性化设计步骤定义为个性化设计进程的一般模型。它是基于引用[23]设计工程中的工作步骤。在实际情况下，并不能总是清楚的划分过程。但这些步骤有助于我们理解个性化设计的概要。

个性化设计步骤如图二所示。



The diagram of personalization design steps is shown in Fig.2. The top of the diagram shows the person as a target customer in personalization design steps. The rectangles represent each step and hexagons are input or output of them. (1)The personalization provider decides the target customer. (2)The provider reads personal information and requests from the customer. Based on the result of the readout, the provider decides the purpose of personalization design and summarizes it as specifications. (3)The provider derives solutions of products and services that meet specifications. (4)The provider realizes the solution through product production and service

provision. It is the most important that the provider feedbacks the result to the customer in order to extract hidden claims in each step. The feedback step is the chance for the customer to judge whether the output is suited for itself. The bottom shows the personalized product and service as a result of personalization design steps. Through these steps, the provider realizes personalization.

图二.个性化设计步骤

图表的顶部显示人在个性化设计步骤中担任目标客户的角色。矩形代表了每个步骤，六边形则代表输入和输出。

（1）个性化提供者决定目标客户。

（2）提供者读取顾客的个人信息和请求。根据读出结果，供应者决定个性化设计的目的，并将其作为具体要求进行汇总。

（3）提供者推出符合具体要求的产品和服务解决方案。

（4）提供者通过产品生产和提供服务实现解决方案。

提供者将结果反馈给客户以便在每个步骤中提取隐藏的要求是十分重要的。反馈步骤是客户判断输出是否适合自己的机会。底部表明个性化的产品和服务是个性化设计步骤的结果。通过这些步骤，提供商实现个性化。

Table 1 shows three cases described according to the process; cases of making an artificial leg, car customization, and recommendation on a web shop. Though the steps are common, the realization methods in each step are totally different case by case. It is observed that the personalization provider in each case has its own procedure. They repeatedly use the procedure to create different products suited for different target customers. We call such procedures as”personalization design procedure”

表1显示了根据该过程描述的三个案例：制作假腿，汽车定制以及网店的产品推荐。虽然这些步骤十分常见，但每个步骤的实现方法都是完全不相同的。据观察，每种情况下的个性化提供者都具有自己的流程。他们多次使用该流程创造适合不同目标客户的不同产品。我们称这样的流程为“人性化设计流程”。



|  |  |  |  |
| --- | --- | --- | --- |
| **步骤** | **制作假腿** | **汽车定制** | **关于网店的建议** |
| 读出 | 假肢测量师测量目标病人的身体并且聆听他/她的请求。 | 汽车经销商向客户展示汽车的选件目录。 | 网络服务器记录顾客的购买和浏览历史 |
| 目标设定 | 假肢测量师假设期望的生活方式和必要的功能。 | 顾客指定他/她的要求。 | 算法分析识别顾客需求 |
| 开发解决方案 | 根据测量，假肢测量师设计了假肢的形状。 | 顾客选择更亲睐的内部和外部部件。 | 通过搜索算法将库存项目和客户需求进行匹配 |
| 生产和实现 | 假肢测量师用石膏制作关节，并将它与膝盖、胫和脚等模块组装起来。 | 在工厂制造商根据订单组装模块。 | 网店展示最匹配的产品，顾客购买产品。 |
| 反馈 | 假肢测量师与病人讨论理想的生活方式。在制作过程中，对患者进行假肢的装配和调整。 | 汽车经销商用3D模型显示设计图像。 | 顾客评估推荐商品是否符合他/她的偏好 |

#### ***3.2. Personalization design procedure***

#### ***3.2个性化设计流程***

For personalization providers working with the personalization design procedure, it is essential to design the procedure corresponding to the requirement that depends on the specific problems. In the following sections, we propose a personalization design method using the personalization procedure. In this method, it is essential for a personalization provider to design proper procedure, the designed procedure determines the quality of personalized products and services and capacity for the number of customers. The next section explains how to design personalization procedure.

对于使用个性化设计流程的个性化提供者，根据取决于具体问题的需求设计流程是至关重要的。在下面的章节中，我们我们提出一种使用个性化流程的个性化设计方法。使用这种方法，个性化服务的提供者必须设计适当的流程，设计的流程决定了个性化产品和服务的质量及客户数量。下节介绍如何设计个性化过程。

## **4. Designing personalization procedure**

#### **4.设计个性化流程**

In this section, we propose a method for designing personalization procedure to support the personalization designer of any products and/or services.

在本节中，我们提出了一种设计化过程以支持个性化设计师的任何产品和或服务。

#### ***4.1. Approach***

#### ***4.1途径***

In this method, the designer first designs the personalization procedure. Then the designer performs the personalization design along to the procedure. For designing a procedure, we assume two embodiment levels; strategy level and step level.

使用这种方法，设计师首先设计个性化流程。然后，设计人员按照流程执行个性化设计。为了设计一个流程，我们假定了两个实施级别：战略级别和步骤级别。

#### ***4.2. Personalization strategies***

#### ***4.2个性化策略***

In the strategy level, the designer decides a strategy for embodying a personalization procedure. Currently, we derived eight strategies from the analysis of existing personalization cases (see Table 2). Each strategy has three characteristics of timing, evaluation, and differentiation. Timing denotes whether the personalization is executed before use or during use.Evaluation shows how to evaluate the personal fitness;depending on the customer’s subjective judgement or using the

objective evaluation methods. Individuality indicates whether the output product and service as a personalized solution is absolutely one-off or common for a group of some people.

在战略层面，设计师决定实施个性化流程的策略。目前，我们从现有的个性化案例分析中推导出八种策略。（见表二）。每一种策略具有时间、评价和区分三个特征。时间段表示在使用之前或使用期间是否执行个性化。评估显示怎样去提高个人适应度；取决于顾客的主观判断或者使用客观的评估方法。个性表示作为个性化结局方案的输出产品和服务对于一群人来说是绝对一次性的还是普通的。

#### ***4.3. Patterns in personalization steps***

#### ***4.3个性化步骤中的模式***

In the step level, a designer should embody each personalization steps of the procedure as shown in Fig. 2, according to the selected strategy. The proposed method supports the designer by indicating typical patterns of the embodiment of each step. From the analysis of cases of personalization we collected, we found several patterns for each step (see Table 3).

在步骤级别，设计师应该根据从图2中展示中选择的策略，体现流程的每个个性化步骤。所提出的方法通过指示每个步骤具象化的典型模式来支持设计者。从我们收集的个性化案例分析中，我们找到了每个步骤的几种模式（见表3）。

####

|  |  |  |
| --- | --- | --- |
| **步骤** | **模式** | **例子** |
| 读出 | 让顾客填写一份调查问卷和顾客进行交谈测量参考存储的数据 | 酒店员工做调查改善服务一个顾客和裁缝谈话并告知需求假肢测量师测量客户残缺部位的形状自动更正系统引用文本输入的日志 |
| 目标设定 | 旨在满足客户的要求为客户估算期望状态 | 顾客可以根据自己的喜好选择应用网店试图向顾客推荐他们意想不到的东西一个汽车经销商为新车准备了各种选项，一位顾客选择了其中一些 |
| 解决方案开发 | 准备模块对应各种功能和装配准备原型和修改根据顾客的特征匹配准备好的解决方案准备参数调整机制，寻找合适的参数 | 网店的推荐引擎从库存中发现与客户偏好相对应的产品健身服务供应商由于客户的身体素质，准备健身计划，并改变时间和强度裁缝用布料做新衣服 |
| 生产和实现 | 从材料生产新产品更改系统设置或配置组装模块从库存中检索选定项目 | 客户在智能手机上安装应用程序工厂工人根据顾客选择组装汽车模块一家网店准备大量的产品并推出必要的产品 |

#### ***4.4. Method to design the personalization procedure***

#### ***4.4设计个性化程序的方法***

Based on these levels, the outline of the design of the personalization procedure consists of two stages as follows:

1. Select a personalization strategy suitable for the design problem

2. Deploy the strategy into combinations of the patterns of each personalization step.

3. Modify the patterns to adapt the managing problems.

基于这些级别，包含两个阶段的个性化过程设计的概要如下：

1.选择适合设计问题的个性化策略

2.将策略部署到每个个性化步骤的组合模式中

3.修改模式以适应管理问题

## **5. Case Study: Personalization design of coffee**

#### **5.案例研究：咖啡的个性化设计**

To demonstrate our methodology, we designed personalization procedure for coffee service. The preference for coffee taste and aroma varies from person to person. The personalized coffee service needs to understand personal preferences and appropriately change the properties of the coffer.

为了证明我们的方法，我们设计了咖啡服务的个性化流程。咖啡的味道和香气偏好因人而异。个性化咖啡服务需要了解个人喜好并适当改变咖啡柜机的性能参数。

First of all, we selected the strategy ????upgrading for a person for personalization procedure of coffee service. This strategy requires for the procedure to derive certain product category through customer’s subjective evaluation during use.The reason for the selection is that the taste is subjective and the customer can discover hidden preference with repeatedly drinking coffee.

首先，我们选择了“为个人升级”的咖啡服务个性化流程策略。该策略要求流程通过在使用期间客户的主观评估来推导出特定的产品类型。选择的原因是主管的味觉感知及顾客可以通过重复饮用咖啡发现隐藏偏好。

Secondly, we deploy the selected strategy into personalization steps. For readout step, we selected pattern of filling a questionnaire to get the subjective opinion without human labor. For goal setting step, we selected the pattern of estimating desirable state, because we assumed that customers do not know their preferences. For developing solution step we selected the pattern of matching prepared solution with Customers’ property because we should take advantage of existing sophisticated coffee types that were established in a long history. For production and realization step we decided to change parameter setting to change the taste of coffee. To upgrade the personal fitness, we decided to feedback customer’s assessment of the output coffee.

其次，我们将选定的策略部署到个性化步骤中。为了读出步骤，我们选择填写问卷的模式以获得没有人工干涉的主观意见。对于目标设置步骤，我们选择了理想估计状态的模式，因为我们假设客户并不知道他们的偏好。为了开发解决解决方案步骤，我们选择关联准备好的基于顾客特性的解决措施模式，因为我们应该利用现存的复杂的具有悠久历史的咖啡类型。为了生产和实现步骤，我们决定改变参数设置以改变咖啡的味道。为了提高个人适应水平，我们决定反馈客户输出的咖啡评估。

As a result of this methodology, we designed a smart coffee maker which can provide preferable coffee for any customer. When the coffee maker provides coffee to any customer, the machine asks some questions at the same time. The answer from the customer is matched with a prepared coffee recipe. At the next time, the coffee maker provides a new taste of coffee

that is expected to fit to the customer.

作为这种方法的结论，我们设计了一种智能咖啡机，可以为任何客户提供可口的咖啡。当咖啡机向某位顾客提供咖啡时，机器会同时提出一些问题。客户的答案将与准备好的咖啡配方相匹配。在下一次，咖啡机会提供一种新口味的咖啡，将会适应顾客。

This scenario is a possible example of the personalization.If a designer chooses other strategy or pattern, the procedure will be completely different.

这种情况是个性化的一个可能的例子。如果设计师选择其他策略和模式，流程将会完全不同。

## **6. Discussion**

#### **6.讨论**

We proposed the methodology of personalization design focusing on the procedures to personalize more products and services. The case study shows an easy example of implementations of our methodology and demonstrates the possibility to personalize coffee with a systematic procedure. It means that our methodology does not depend on the human skill and can have a large capacity for the number of customers.

我们提出了个性化设计的方法，重点在于使更多产品和服务的流程个性化。案例研究展示了我们方法实施的简单案例，并展示了通过系统流程来个性化咖啡的可能性。这意味着我们的方法并不依赖人的技能，并且可以为客户数量提供足够大的容量。

A remained issue is the cost-effectiveness of design and manufacturing personalized products. In today's manufacturing system, manufacturing one-off product is too expensive for the individual customer. Meanwhile, the introduction of ICT technology into the manufacturing industry, called industrial Internet and Industry 4.0, is expected to reduce manufacturing costs [25, 26]. The major factors are advanced collaboration among factories and intelligent machine tools. Such production system linked with information technology is expected to drastically decrease the cost of mass customization and make personalization design cost-effective.

现在任然存在的问题是设计和制造个性化产品的成本效益。在当今的制造系统中，制造一次性产品对于客户而言太过昂贵。同时，将ICT技术引入制造业，以及在被称为工业互联网和第四次工业革命的背景下，制造成本将降低。[25][26]主要因素是工厂和智能机床之间的先进协作。这种与信息技术相结合的生产系统有望大幅降低大规模定制的成本，使个性化设计具有成本效益。

Another issue is how personalization design reduces the environmental impact of product and services throughout the life cycle. Depending on the content, the environmental impact

of personalized products or services may rise compared to that of conventional ones. For example, production of additional parts which diversify products consumes excessive resources.

The effectiveness of personalization on environmental impact should be evaluated with a quantitative method such as life cycle assessment. It is a future task to integrate the evaluation

into the personalization design process.

另一个问题是个性化设计如何减少产品和服务在整个生命周期中对环境的影响。根据内容，与传统产品相比，个性化产品或服务对产品的影响可能会增加。例如，生产使产品多样化的附加部件消耗过多的资源。个人化对环境影响的有效性应使用生命周期评估等定量方法进行评估。将评估整合到个性化设计过程中是未来的任务。

Many challenges remain in the proposed methodology. It does not show the relationship between each strategy and each pattern of personalization steps. Also, it is required for the

methodology to clarify the advantages and limitations of each strategy and patterns. For these reasons, the methodology for personalization design is needed to be more developed.

所提出的方法仍面领着许多挑战。它并没有显示每个策略与每个个性化步骤模式之间的关系。此外，该方法需要澄清每个战略和模式的优点和局限性。出于这些原因，个性化设计及的方法需要更加发展。

## **7. Conclusion**

#### **7.结论**

In this paper, we proposed the concept of personalization design for individual customers to achieve personal aims and expected situation through providing products or services. We introduce the personalization procedure based on the analysis of the process in some cases. Then we propose the methodology to design the procedure with two conceptual levels of personalization. We conduct a case study to demonstrate the methodology.

在本文中，我们提出了个性化设计的概念，为了个人用户实现了个人目标和通过提供产品和服务得到的预期情况。在某些情况下，我们会根据过程分析介绍个性化流程。然后我们提出两个概念层次的个性化设计流程的方法。我们进行案例研究来演示方法。

**Abstract:**

The application of design methods in engineering practice is improvable,although the use of methods is often seen as helpful and even profitable with regard to process efficiency and effectiveness. The main barriers cited to apply design methods in practice are the theoretical descriptions and the complexity of methods. Thus, this paper focuses on new media to provide method knowledge in order to overcome the above mentioned barriers. The approach presented is based on method videos to explain the aim and application of methods.

**内容摘要:**

尽管在进程效率和有效性方面使用方法经常被认为是有用的，甚至是有利可图的，设计方法在工程实践中的应用是可以改进的。 在实践中引用设计方法的主要障碍是描述理论和方法的复杂性。 因此，本文着重介绍新媒体提供方法知识以克服上述障碍。 所介绍的方法是基于方法视频来解释方法的目的和应用。

**Key words:**

Design Methods, Knowledge Transfer, Design education

**关键词:**

设计方法，知识转移，设计教育

## **1. Motivation**

## **1.动机**

Considering the fact that knowledge generation, validation,and documentation are decisive aspects of productdevelopment, efficient knowledge handling throughout the entire product development process becomes a key role. Thus,systematic approaches within the design process will become increasingly important. Development and innovation management provide various methods to support the product development processes (PDP). The term “method” is often

understood as a rule-based planned sequence of activities [1].So far, some methods have been widely used in companies, but most methods are rarely known and thus only used to a restricted extent [2]. The reasons for a poor application in practice are, e.g., the lack of know-how regarding an effective integration into the product development process [3] or the missing adaption possibilities of methods to the company's situation, e.g. [4]. Hence, a demand and situation-specific supply of design methods in practice should be an important objective of methods research. Therefore, the preparation and tailor-made provision becomes a key role in the transfer ofmethods from research to practice [5].

考虑到知识生成、验证和文档是产品开发的决定性方面，整个产品开发过程中高效知识处理成为了关键角色。因此，设计过程中的系统方法变得越来越重要。开发和创新管理提供各种方法来支持产品开发过程（PDP）。术语“方法”通常是被理解为基于规则的计划活动序列[1]。到目前为止，一些方法已被广泛应用于公司，但大多数方法很少被人们所知，因此仅作用于有限的范围[2]。在实践中应用不当的原因主要有以下例子，缺乏有效整合到产品开发过程中的专业知识[3]或方法对公司情况缺乏适应的可能性 [4]。因此，在实践过程中，特定情况下满足需求来支持设计方法应该是方法研究的一个重要目标。因此，编制和量身定做的规定成为了方法从研究转向实践的关键角色[5]。

## **2.State of the Art**

## **2.技术发展水平**

#### ***2.1. Design Methods in Practice***

## **2.1 实践中的设计方法**

Methods describe a goal-oriented procedure. Thus, they have a descriptive and instructional character and should support the user to achieve a certain goal. However, the outcome of the application of a method is open [1][6]. For instance,Lindemann [1] defines the term "method" as the description of a rule-based and planned action to perform certain activities according to its specification. Thus, methods provide a step by step procedure to solve a specific problem. A method can include the use of different tools in order to achieve the goal.They can comprise guidelines which tools should be used as well as the order in which they should be applied. Due to the diversified work within product development, numerous methods for different goals have been developed such as analysis method, idea generation/solution finding methods,evaluation methods and cost and economic methods.

方法描述了一个面向目标的过程。因此，它们具有描述性和指导性的特征，并且应该支持用户以达到特定的目标。然而，应用方法的结果是开放的〔1〕〔6〕。例如，琳德曼（1）将术语“方法”定义为基于规则和计划的行动的描述，以根据其规范执行某些活动。因此，方法提供一步一步的程序来解决特定的问题。一种方法可以包括使用不同的工具来实现目标。它们可以包括使用工具的准则以及它们应该被使用的顺序。基于产品开发过程中的多样化工作，开发了多种方法，如分析方法、思想生成/解决方法、评价方法、成本和经济方法。

In general, these methods use experiences already gained to solve repeating problem patterns. This refers not only to the support of the engineer and the management, but also to the support of facilitating organization, planning, and concept development [6][7]. Despite the wide range of support,methods have been insufficiently integrated into daily development practice so far and even in this context, have only rarely fully exploited in their potential [8]. Franke et al. [9] find that successful firms use methods during PDP more frequently.These methods are not only used in the idea phase but also during the conceptual design and later stages of the PDP. Yeh et al. [10] show that methods appear to be effective although engineers use them rarely in practice. By analyzing more than 400 development projects from practice, Graner [5] showed that an integrated method application can strongly support the engineer in the product development process. In these projects, the intensive method use was correlated to the success of the new product. In practice, however, methods are not regularly used and only a few of them are accepted [6][11]. Recent research on this lack of acceptance concludes that science is often too far away from reality, e.g. [12][13]. The individual needs abilities of the engineer as well as individual working,and thinking patterns have been taken into insufficient consideration [4]. In addition, the verifiability of improved results and decreased development effort due to the method application can only be revealed to a limited extent, meaning under specific conditions. Furthermore, there is mainly a missing expertise about how methods can be appropriately integrated into the PDP [14]. Another reason mentioned for criticism is that methods are often complex and theoretically described [2].

一般来说，这些方法使用已经获得的经验来解决重复问题的模式。这不仅涉及到工程师和管理层的支持，还涉及到促进组织、规划和概念发展的支持[6 ] [ 7 ]。尽管有广泛的支持，但迄今为止还没有充分整合到日常发展实践中，甚至在这种情况下，很少有充分利用其潜力的〔8〕。弗兰卡等。〔9〕发现成功的企业在PDP中使用的方法更为频繁，这些方法不仅在PDP阶段使用，而且在PDP的概念设计和后期阶段中使用。耶等。〔10〕表明，尽管工程师在实践中很少使用这些方法，但这些方法似乎是有效的。通过对400多个开发项目的实践分析，格拉纳（5）表明，集成方法应用程序可以在产品开发过程中强有力地支持工程师。在这些项目中，强化方法的使用与新产品的成功相关。然而，在实践中，方法并不经常使用，只有少数被接受[6 ]〔11〕。最近对这种缺乏接受的研究得出结论，科学离现实太远了，例如[ 12 ]〔13〕。工程师的个人需求能力和个人工作能力，以及思维模式都被忽略了[ 4 ]。此外，这意味着在特定的条件下，改进的结果的可验证性和由于方法应用而减少的开发努力成本只能在有限的程度上被揭示。此外，主要的一点是，缺少如何将方法适当地集成到PDP（14）中的专门知识。受到批判的另一个原因是，方法往往是复杂的和仅在理论上描述的〔2〕。

Two independently conducted studies on the methods application in practice showed that analysis, creativity, and evaluation methods are most applied in practice [15] and [16].The focus of both studies laid on the use of methods along real ongoing product development processes. The additional finding was that, for example, creativity methods are used not only during the idea generation but also for the support of profile detection and modeling of principle solution and embodiment. Both studies show independently of one another that only a small number of methods is used in practice.Bavendiek et al. [16] report 4 to 5 methods on average being applied at least rarely. Albers [15] finds a small number of selected methods within a method category. For example,almost every engineer (98 %) uses brainstorming in the field of creativity methods, while other methods such as 6-3-5 (42 %) or brain writing (36 %) are less than half as often used.Regarding the evaluation of the suitability of methods, it is conspicuous that even the methods used infrequently are considered as successful. For instance, brainstorming, as one of the creativity methods, was by far the most frequently stated method, whereas the suitability of other creativity methods was evaluated constantly well. The results show that the variety of methods developed in the past and hence the subsequent potential is not yet sufficiently exploited in practice. Many designers see no improvement by using methods. Most of them are of the opinion that without the use of methods just as good results as without can be achieved in even less time. Thus, it happens rarely that an engineer independently accesses methods [15].

两个独立进行的方法应用实践研究表明，分析、创造力和评估方法在实践中最为实用[15-16]。两项研究的重点都放在了沿着真正的产品开发过程使用方法。额外的发现是，创意方法不仅在创意产生期间被使用，而且被用于支持轮廓检测、主要解决方案和实施案例的建模。两项研究都显示彼此独立，实践中仅使用了少量方法.Bavendiek et al。 [16]报告显示至少4至5种方法很少被应用。 Albers [15]在方法类别中发现了少量选定的方法。例如，几乎每个工程师（98％）都在创造性方法领域使用头脑风暴，而其他方法如6-3-5（42％）或大脑写作（36％）则少于使用经常使用量的一半。关于评估方法的适用性，即使不经常使用的方法也被认为是适用的，这是显而易见的。例如，当其他创造性方法的适用性经常得到很好的评估时，作为创造力方法之一的头脑风暴仍是迄今为止最常用的方法。结果表明，过去开发的各种方法以及随后产生的潜力尚未在实践中得到充分的利用。许多设计师通过使用方法看不到改进。他们中的大多数人认为，如果不使用方法，就可以在更短的时间内获得好的结果。 因此，很少有工程师单独使用方法[15]。

#### ***2.2. How to increase the Acceptance of Design Methods?***

## **2.2 如何提高设计方法的接受度？**

To meet the above mentioned problems of methods within industry projects, various approaches have been presented.Geis et al. [3] propose a method transfer framework which consists of four pillars (simplification, adaption, promotion and training of methods) as well as of the basis of daily routine in industry, knowledge of designers and experience in science.These aspects contribute to a better acceptance and successful usage of methods in industry [3]. Stetter and Lindemann [8]developed another transfer model for methods consisting of five steps from the initiation of a method implementation process up to the evaluation of the impact of the introduced methods [8]. In literature, there are further models and approaches to increase the acceptance of methods in industry, e.g. [17]. Many of those authors deal with the question how to provide knowledge about methods. Beside the descriptions in literature like Pahl/Beitz [18], there are special books or collections containing several design methods, e.g. the Delft Design Guide [19]. Another way to describe methods and to provide the necessary knowledge about how to apply them are online platforms or, more recently, applications. An example for an online platform like that is the “Methodos” portal which was developed at TU Braunschweig with the purpose of teaching methods to the engineering design students in a more attractive and interactive way [20]. Beside different options to search for adequate methods, there are already method videos, helpful tools and templates attached to the method descriptions. Via comments it is possible to share gained experiences with other users. The first method application designed for mobile devices called “InnoFox” was presented in 2014 by the Karlsruhe Institute of Technology [15]. It provides a huge catalogue of design methods and various possibilities to access methods which are suitable to the situation given by the company’s surroundings [21].

为了满足上文提及的工业项目中出现的方法问题，已经提出了各种解决措施.Geis等人[3]提出了一个方法转移框架，包括四个支柱（简化，适应，推广和方法培训）以及日常工业的基础、设计人员的知识和科学经验。这些方面有助于更好地验收应用效果和成功使用工业方法[3]。 Stetter和Lindemann [8]为方法构建了另一种转移模型，包括从方法实施过程开始到评估引入方法的影响的五个步骤[8]。在文献中，有更多模型和方法来提高工业中方法的接受度，例如， [17]。许多作者处理如何提供关于方法的知识方面的问题。除了像Pahl / Beitz [18]这样的文献中的描述外，还有包含几种设计方法的特殊书籍或集合，例如，代尔夫特设计指南[19]。另一种描述方法并提供关于如何应用它们的必要知识的方法是在线平台或最近新兴的应用程序。这种在线平台的一个例子就是在TU Braunschweig开发的“Methodos”门户，其目的是以更有吸引力和更具交互性的方式向工程设计专业的学生教授方法[20]。除了用于搜索适当方法的不同选项之外，方法说明中还附带了方法视频、有用的工具和模板。通过评论可以与其他用户分享获得的经验。卡尔斯鲁厄理工学院于2014年提出了第一个为移动设备设计的称为“InnoFox”的方法应用程序[15]。它提供了一个巨大的设计方法目录和各种可能性，让用户来访问适合公司环境的方法[21]。

The approaches and tools mentioned to transfer knowledge about design methods into practice directly or via a lasting design education can already solve some of the problems of design methods in practice. A promising further step is the combination with explanatory videos of methods, like they are implemented in the Methodos portal yet.

所提及的方法和工具，将设计方法的知识直接或通过持久的设计教育转化为实践，已经可以在实践中解决设计方法的一些问题。另一个展望是与方法的说明性视频相结合，就像它们在Methodos门户中实施一样。

#### ***2.3. Explanatory Videos for the Knowledge Transfer***

## **2.3 知识转移的解释性视频**

Explanatory videos are defined as short animated videos to explain a complex issue. In this contribution, the focus lays on method videos that describe design methods used within the engineering design process. Videos are a commonly used medium for giving a short overview of the issue to be explained. With the aid of pictures and sounds, the audience is addressed visually and aurally. If used correctly, this

combination leads to a better understanding and increased memory performance by the spectator. For example,Chirumalla et al. conducted a study to identify the influences of the medium on an assembly process. The process was described with text only, with drawings and text, with pictures only and with a video. The video was best rated to understand these instructions as the combination of pictures and sound was helpful to the participants [22].

解释性视频被定义为通过短动画视频来解释复杂的问题。在本文中，重点放在描述工程设计过程中使用设计方法的方法视频上。视频是一个常用的介质，用于简要介绍要解释的问题。借助图片和声音，观众可以通过视觉和听觉进行处理。如果使用正确，这组合将会使观众能更好的理解和增加的记忆表现。例如，Chirumalla等人进行了一项研究，以确定传播介质对装配过程的影响。该过程采用了仅用文字描述、图纸和文字、仅带图片和视频四个条件。视频是最好是理解这些说明的介质，因为图片和声音的组合对参与者理解有帮助[22]。

Looking at websites like Youtube, both the demand and the supply of explanatory videos, seem to rise further. There are various explanatory videos on diverse topics available. Giving the example of the youtube channel "explainity" which has currently more than 100 explanatory videos on politics,economics and health care online, shows the enormous demand for explanatory videos: the channel has more than 80000 abonnements and has had more than 8 million views since March 2011 [October 2016]. Especially students at high schools are used to watch videos provided online to complete knowledge gaps from the classes [23]. A survey among students from high schools concerning their usage, production and publication of online videos indicates that more than 60 % of them watch explanatory videos to prepare for exams and presentations. Similar findings can be reported for students with an academic background [16]. The main advantages of video based learning is seen in the increased individuality of knowledge acquiring. Videos can be stopped and it can be returned to a certain point when dealing with complex issues. Thus, regarding method videos, the method portal "Methodos" including several explanatory videos is provided supplementary to the lectures and exercises.

纵观Youtube等网站，解释性视频的需求和供应似乎都进一步上升。不同的解释性视频可用于不同的主题。举例来说，YouTube“解释性”相关的频道，目前有超过100部关于政治，经济和医疗保健的解释性视频，显示了对说明性视频的巨大需求：自2011年3月[截至2016年10月]以来，该频道拥有超过8万个视频，并拥有超过800万的观看次数。特别是用来给处于高中的学生观看，以完成课堂知识的差距而在线提供的视频[23]。一项针对高中学生使用、制作和发布在线视频的调查显示，超过60％的学生观看演示视频，是为考试和演示做准备。在具有学术背景的学生中可以得到类似的结果[16]。基于视频的学习的主要优点体现在知识获取的个性化。在处理复杂问题时，可以停止视频并将其返回到某个点。因此，关于方法视频，包括几个解释视频的方法门户“Methodos”被提供为对讲座和练习的补充。

Summing up, the relevance of explanatory videos in both education and practice has been rising. Hence, in the engineering design context, the relevance of method videos in particular should be investigated, as these videos can be assumed helpful for transferring knowledge. In this context,factors that contribute to a successful transfer of knowledge from science to practice or in education are defined as success factors. Aspects that hinder the transfer are named barriers in the following.

总之，解释视频在教育和实践中的相关性一直在上升。因此，在工程设计环境中，应该调查方法视频的相关性，因为这些视频可以被假定为是有助于传播知识的。在此背景下，有助于将知识从科学成功转化为实践或教育的因素，将被定义为成功因素。阻碍转移的方面则在下文中被命名为障碍。

## **Research and Methodology**

## **3.研究和方法**

The approach of this contribution is to use explanatory videos to teach design methods in design education as well as in practice. Both at Karlsruhe Institute of Technology (KIT) and at Technische Universität Braunschweig, several methods were produced as method videos and provided to students and industry partners within different case studies. The aim was to answer the following research questions:

* How is the acceptance of method videos in designeducation and practice?
* Which success factors of method transfer to practice can beaddressed by method videos?
* Subsequently, what are the main elements of a successfulmethod video?

In this contribution, three case studies will be presented. The results will be compared to identify the main elements of successful video forms and to gain information on the acceptance of the videos as medium to transfer method knowledge. In the end, the results will be used to match success factors of method knowledge transfer known from literature to the elements or characteristics of the method videos. This will give insights how to design successful explanatory method videos in general.

这个贡献的方法是使用解释性视频来教授设计教育过程中的设计方法以及实践。在卡尔斯鲁厄理工学院（KIT）和布伦瑞克工业大学，有几种方法被制作为方法视频，并在不同案例研究中提供给学生和行业合作伙伴。目的是为了回答以下研究问题：

方法视频在设计教育和实践中的接受程度如何？

方法视频可以将方法转化为实践有哪些成功因素？

随后，成功方法视频的主要内容是什么？

本文将介绍三个案例研究。结果将进行比较，以确定成功的视频形式的主要内容，并获得视频作为媒介转移方法知识的接受程度的信息。最后，将结果用于将已知的方法知识转移的成功因素与方法视频的元素或特征相匹配。这将提供如何设计一般成功的解释方法视频的见解。

## **4.Case studies in Design Education and Practice**

## **4.设计教育与实践案例研究**

Before presenting the case studies in detail, the structure and general elements of the method videos will be explained.

The method videos at TU Braunschweig as well at KIT are set up in a similar style: there is always the protagonist. He or she is an engineer or engineering student who receives a task that he or she solves with the aid of the explained method. Thus, the video presents to the audience how the protagonist applies the method in question. In this way, the barrier to use the method in the following shall be reduced. The videos were created in a simple and attractive way using Microsoft Power Point or VideoScribe. The narrator tells the story around the protagonist and the method application off-camera. The repeating structure of these videos and the simple illustration are added by exhilarating supplements to enhance the entertainment value. The length of the videos is less than 7 minutes. Keywords are used for an easier understanding.

在详细介绍案例研究之前，将解释方法视频的结构和一般元素。

在Tun-BrunsWeigg和KIT的视频制作方法也有相似的风格：总是有主角。他或她是一个工程师或工程专业的学生，他们接受他或她在解释的方法的帮助下解决的任务。因此，视频向观众呈现主角如何应用该方法解决问题。这样，就减少了在下面使用该方法的障碍。这些视频是用微软Power Point或VixOsCube以简单而有吸引力的方式制作的。讲述者讲述了围绕主人公的故事和镜头外的方法应用。这些视频通过令人兴奋的补充来增加的重复结构和简单的图示，以提高娱乐价值。视频的长度不到7分钟。关键字被用来更容易理解。

#### ***4.1. Case Study Synectic in Education***

## **4.1 个案研究在教育中的应用**

The first case study to be presented was performed within lectures from the Bachelor and Master programs in the field of engineering design at Technische Universität Braunschweig. Accompanying the lectures and exercise classes the interactive method portal "Methodos" was introduced and provided to the students [20]. This online portal contains design methods taught in those courses. Beside verbal and graphical descriptions of the methods, several method videos are offered,e.g. explaining the Morphological Box, the Quality Function Deployment as well as Synectics. The purpose of these method videos is primarily for self-study. The students have free access to the videos via the method portal “Methodos” as well as in online courses. In exercise classes and in online courses, the students receive a small development task, in which they have to apply a method. The information on the method has to be found in the portal or through the videos. Teachers answer the students’ questions an give feedback on results in the present class or via email or the online teaching platform. Additionally, some videos are used in the lectures to demonstrate and explain the method. In this context, the above-mentioned method videos were evaluated within the corresponding courses duringthe past year.

In the following, the evaluation of the method video “Synectic”within a bachelor course on basics of product development andengineering design in winter 2015/2016 is presented.

第一个案例研究是在BunnsWig理工大学工程设计领域的学士和硕士课程的讲座中进行的。伴随着讲座和练习课，交互式方法门户“MeoDOS”被引入并提供给学生[20]。这个在线门户包含了在这些课程中教授的设计方法。除了语言和图形描述的方法，提供几种方法视频，例如解释形态框，质量功能部署，以及协同学。这些方法视频的目的主要是为了自学。学生可以通过方法门户网站“MeoDOS”和在线课程免费访问视频。在练习课和在线课程中，学生接受一个小的开发任务，在其中他们必须应用一种方法。该方法的信息必须能在门户或视频中找到。教师当面或通过电子邮件或在线教学平台，回答学生的问题，给出课堂上的结果反馈。此外，在讲座中使用了一些视频来演示和解释该方法。在此背景下，上述方法视频在过去一年的相应课程中得到评价。

下面，介绍了2015/2016年度《产品开发与工程设计基础》课程中视频“SycCeic”的评价方法。

In the years before, the method was explained in the lecture using slides and a description in the lecture notes. This time,Synectic was explained only by the aid of the method video.Afterwards, the students evaluated the video via a questionnaire. The questionnaire consisted of two parts: the first part was a small quiz with three questions on the Synectic method. This served to figure out whether the students followed the video attentively, as the answers were not obvious. For each question there was only one correct answer.The second part of the questionnaire contains questions on the video in general but also on single elements to identify weak points and success factors of the video. In addition, the students were asked if they had known the method before.

52 valid questionnaires were returned. The results of the second part of the questionnaire are shown in Figure 2. All students estimated that they understood the method.

在过去的几年中，该方法在讲座中使用幻灯片和讲稿中的说明进行了解释。这一次，仅通过借助方法视频解释了戈顿法，之后，学生通过问卷对视频进行评价。问卷由两部分组成：第一部分是一个小测验，共有三个问题。这有助于弄清楚学生是否认真地关注了视频，因为答案并不明显。每一个问题只有一个正确的答案。问卷的第二部分包含一般视频上的问题，还包括单个元素来识别视频的弱点和成功因素。另外，学生们被问到他们以前是否知道这个方法。

有效问卷52份。问卷第二部分的结果如图2所示。所有的学生都大概表示他们理解了这个方法。

Compared with the results from the quiz, this seems appropriate. Out of 156 answers in the quiz, only eleven were incorrect. Out of these, six answers were given by four students who indicated that they had known the method before (in total,ten students knew the method before). So, there is a successful transfer of the knowledge on the Synectic method for the main part of the participants. The voice and the illustrations of the video were about 75 % understandable and almost the rest“rather” understandable. The time is rated as adequate (above 70 %) and the pace at 60 % adequate. Except for 5 % of the students, the example in the video (development of an innovative nutcracker) was comprehensible or rather comprehensible to explain the method. The medium video was completely estimated as (rather) suitable. The students were not sure whether they could think of a better method, but mainly

said “rather no” (about 70 %). Finally, 30 % of the students were even motivated to apply the method in the future. This happened one week later, when the students were given the task to develop a principle solution for a valve. Four out of eight teams chose the Synectic method and applied it. In comparison with the other teams (applying Brainwriting or Gallery Method), these teams came up with ideas inspired by nature which leads to more unconventional solutions. However, the Synectic teams gathered fewer solutions than the others did.

Overall, the Synectic video has a positive influence when teaching the method. The knowledge on the method can be transferred in a very fast way, independently of the teacher and in a motivating style. Success factors in this video are assumed to be the clear structure, the story with Tom as the protagonist and his experiences with the method, the simple illustrations and some exhilarating supplements that contribute to the entertaining effect of a video.

与测验结果相比，这似乎是正确的。在测验中的156个答案中，只有十一个不正确。其中，四名学生给出了六个答案，他们表示他们之前已经知道该方法（其实总共有十名学生知道该方法）。因此，参与者的主要部分已经成功地转化了关于新方法的知识。视频的声音和插图大约有75％可以理解，其余几乎都可以“相当”于理解。时间被认为是足够的（70％以上），并且60％的速度足够。除了5％的学生之外，视频中的例子（开发创新的胡桃夹子）对于解释该方法而言是易于理解或易于理解的。中等视频被完全估计为（相当）合适。学生们不确定他们是否能想到更好的方法，但主要是说“相当不”（约70％）。最后，30％的学生甚至有动机在未来应用这种方法。这发生在一周后，当时学生们被赋予了开发阀门主要解决方案的任务。八支队伍中有四支队伍选择了Synectic方法并应用它。与其他团队（应用脑力写作或画廊方法）相比，这些团队提出了灵感来自大自然的想法，这导致了更多非常规解决方案。然而，与其他人相比，Synectic团队收集的解决方案更少。

总体而言，在教授这种方法时，Synectic视频具有积极影响。关于该方法的知识可以以非常快速的方式传递，独立于老师和并且以激励的方式传递。本视频中的成功因素被认为是清晰的结构；汤姆作为主角的故事；以及他对方法的经验；简单的插图和一些令人兴奋的补充，这些都有助于视频的娱乐效果。

#### ***4.2. Case Study FMEA in Student Development Projects***

## **4.2 FMEA在学生发展项目中的案例研究**

The creation of explanatory videos for the methodological support of student development team is part of this section.Therefore, explanatory videos were created for the methods of 6-3-5, Sounding Board, Scrum, and FMEA. It is intended to arouse curiosity and encourage the students to take a more intensive look at methods. The videos should also make the entrance easier. This increases efficiency, reduces education and learning time and accelerates the implementation of new methods in processes. The aim of the explanatory video is to provide a guideline for the steps of a correct application of the method. Furthermore, an example is given which can be used as a template for the application. The video ends with a summary of all phases of the FMEA. This Video can be seen on

(https://www.youtube.com/watch?v=JTI8Bm4kdkc).

The explanatory video for the FMEA has been validated in avalidation study in the project "Integrated Product Development" at the Institute for Product Development. Here the students passed the whole product engineering process,based on an assignment of an industrial project partner. The results are shown in the Figures 3 and 4.

为学生发展小组提供方法支持的解释性视频是本节的一部分，因此，为63-5、发声板、Scrum和FMEA的方法创建了解释性视频。它的目的是唤起人们的好奇心，鼓励学生对方法进行更深入的研究。视频也应该让入口更容易进入。这提高了效率，减少了教育和学习时间，并加速了新方法在过程中的实现。解释性视频的目的是为正确应用该方法的步骤提供指南。此外，给出了一个可以作为应用程序模板的例子。视频结束的FMEA的所有阶段的总结。这个视频可以通过该链接访问（https://www.youtube.com/watch?v=JTI8Bm4kdkc）。

FMEA的解释性视频已在产品开发研究所“集成产品开发”项目中进行了验证研究。在这里，学生们通过一个工业项目合作伙伴的任务，完成了整个产品工程过程。结果显示在图3和图4中。

40 people in total filled out the questionnaire. In the first block,the factors familiarity with methods, confidence in working with methods, learning experience, and motivation were queried. The survey was based on a scale from 1 (very low) up to 5 (very high). Figure 3 shows that a greater confidence in working with the method was felt among the groups who had seen the video before. The information was considered more useful than in the group that could prepare themselves only with a textual description. Figure 4 (left) focusses on the problems encountered in the implementation of the method. So,without the video, it was more often reported that there have been problems with the understanding of the context of the method. An even bigger difference can be seen in the terminology. Here, 27 % of the participants of the project groups with the video stated to struggle with the terms of the FMEA. The majority of the participants without videos report problems with the terminology. Regarding the question how long the teams have estimated to be used until they could start with the FMEA (see Figure 4, right), participants without the video considered the time needed 1.5 minutes longer. This corresponds to approx. 12 % of the training time.

一共有40人填写问卷。在第一个块中，询问了熟悉方法的因素、使用方法的信心、学习经验和动机。这项调查采用了1（非常低）到5（非常高）的刻度。图3显示，在以前看过视频的小组中，对使用该方法的信心更大。信息被认为比在小组中更有用，他们可以用文字描述来准备自己。图4（左）重点讨论了在实现该方法时遇到的问题。因此，没有视频，人们经常表明，在理解该方法的上下文中存在问题。在术语中可以看到更大的差异。在这里，27%的参与者的项目组与视频表示与FMEA条款产生了斗争。大多数没有视频的参与者报告了术语的问题。关于团队估计使用多长时间，直到他们可以通过FMEA开始（见图4，右），没有视频的参与者认为时间需要1.5分钟更长。这相当于大约12%的训练时间。

To compare the quality of the results, all possible causes of the errors were collected and declared as 100 %. The groups with video preparation found 69 % of the error causes in average,the groups without video preparation only found 57 %.

The validation study has shown that through the explanation videos both a positive impact on the quantity and the quality of the results was achieved. So, more error causes from a larger range of functions could be determined in the teams, in which

the explanatory video was available. It was also evident that the method video has been used as a guideline and could help the teams to carry out the individual steps of FMEA correctly and completely.

In addition, it could be noted that the video helped to clarify fundamental issues concerning the method and its application.

为了比较结果的质量，收集错误的所有可能的原因，并指定全部为100%。视频准备组平均发现69%的错误原因，没有视频准备的组仅发现57%。验证研究表明，通过解释视频，对结果的数量和质量都产生了积极的影响。因此，在团队中可以确定更大范围的错误的原因，其中解释性视频是可用的。很明显，方法视频已经被用作指导方针，并且可以帮助团队正确地并完全地执行FMEA的各个步骤。

此外，可以看出，视频有助于澄清有关方法和应用的基本问题。

#### ***4.3. Case Study: Guidelines for low-inductive Design***

## **4.3 案例研究：低电感设计指南**

Another case study dealt with the mediation of complicated technical circumstances at the example of parasitic inductance.Since inductance is, actually, an electro technical phenomenon,many designers are not very familiar with it. Therefore, an easy explanation of the inductance should be given. Afterwards, the factors of influence were named and explained which specific influence they have on the inductance within the products.After the explanation of these basics, low-inductance constructions were examined in greater detail. To achieve a better learning quality, the duration of every video should be very short which is why the whole contents were split into two videos as follows.

另一个案例是在寄生电感的例子中的复杂的技术环境的处理。由于电感实际上是一种电子技术现象，许多设计者对此并不十分熟悉。因此，应给出电感的简单解释。然后，对影响因素进行了命名并说明了它们对产品内部电感产生的具体影响。在对这些基础进行说明之后，对低电感结构进行了更详细的检查。为了获得更好的学习质量，每个视频的持续时间应该很短，这就是为什么整个内容被分成如下两个视频。

Principles of inductance: Since in the described use case, the designers were excluding machine engineers, there is a need to clarify first the principles of inductance. Therefore, the video explains the definition of inductance, the influencing factors on the inductance and their influence on the components.

Guideline for low-inductive design: After the representation of the principles of inductance, the design guideline for low-inductive design is presented – based on the influencing factors of the inductance, which were already introduced in the first video. In the video, advantages and disadvantages of different solutions were presented. At bad designs, the way for an improvement is explained. With the help of the examples, the guideline is more understandable for the designer.

电感原理：由于在所描述的使用情况下，设计者不包括机器工程师，因此有必要首先阐明电感的原理。因此，视频解释了电感的定义、电感的影响因素及其对元件的影响。

低电感设计导则：在归纳了电感原理之后，根据电感的影响因素，提出了低电感设计的设计准则。在视频中，提出了不同解决方案的优缺点。在糟糕的设计中，解释了改进的方式。在这些例子的帮助下，指南对于设计者来说是更容易理解的。

In order to evaluate the videos, a survey with experts wascarried out. Built on the survey results, the followingconclusions can be drawn:

* The provided videos are very easy to understand because of the help of graphic representation.
* The duration of the videos (in each case 3 minutes) came out to be appropriately valued.
* For presentation purpose, the explanatory video was preferred completed by links to relevant documents.
* The settling-in period in new subjects can be reduced by the videos.
* The video can be used as a reference source, especially for new employees and those who have no basic knowledge about the subject.

为了评估视频，进行了专家调查。在调查结果的基础上，得出如下结论：

所提供的视频是非常容易理解的，因为有图形表示的帮助。

视频的持续时间（在每种情况下3分钟）都得到了好的评价。

为说明目的，解释性视频最好通过链接到相关文件完成。

新录像的安置时间可以通过录像减少。

该视频可以作为参考源，特别是对于新员工和那些没有基本知识的人。

## **5.Resulting success factors of method videos within design education and practice**

## **5.在设计教育和实践中获得方法视频的成功因素**

From the above presented studies, success factors of method videos can be derived. In previous work, e.g. [17][5][12],different success factors as well as barriers for method transfer to practice were described. In this contribution, the existing success factors as well as barriers were considered to identify fitting aspects with regard to the method video, as the results of the three studies show that the knowledge transfer with the aid of these videos has been successful. Starting with the barriers that can be avoided using methods videos, three main barriers were identified as shown in Table 1.

The first barrier to be named regards teaching problems, which can be avoided through a well-prepared and well-rated video with high quality concerning the content. Furthermore, the increase in popularity of explanatory videos suggests method videos to be modern and motivating to transfer and apply the knowledge. The second barrier is the complex presentation of methods, which is met by simple descriptions and examples within the videos. Finally, the problem of not recognized advantages is avoided by showing the context of the method application with the aid of an example and, hence, the benefits in the particular situation.

从上述研究中可以得出方法视频的成功因素。在之前的工作中，例如[17] [5] [12]描述了不同的成功因素以及方法转换到实践的障碍。在这项贡献中，现有的成功因素和障碍被考虑以确定视频方法的适合性方面，作为三项研究的结果表明，借助这些视频的知识转移已经取得成功。从使用方法视频可以避免的障碍出发，确定了三个主要障碍，如表1所示。

要命名的第一个障碍是关于教学方面的问题，可以通过精心准备和良好评价并拥有高质量内容的视频来避免。此外，解释性性视频流行度不断增加，表明方法视频是现代化的，并且有助于传播和应用知识。第二个障碍是方法的复杂表现，视频中通过简单的描述和示例来满足条件。最后，避免了未识别优势的问题。通过在示例的帮助下显示方法应用的上下文，从而在特定情况下显示出益处。

This leads to one of the key aspects contributing to the success of videos concerning the transfer of method knowledge (Table 2). Via stories told in the video, an emotional connection to the audience is built up, so the relevance of the method for the own design process becomes easier to understand. This reveals the success factors convincing and involving people to apply methods. Furthermore, the chosen examples in the videos demonstrate a success story and, thus, can be seen as a kind of a pilot project to convince the engineers of the method presented. The videos are short, so the time to learn the application becomes shorter. The recipient gains certitude in the application of the method, as the only the information needed for the application. Telling the story via the view of a protagonist being faced with a problem, shall lead to a higher motivation to use the method on own, similar problems. To conclude, method videos in particular are supposed to show an additional value in the area of motivation, training time, variety of methods in the application, understanding and quality of results both in teaching and in industry.

这是导致视频方法知识转移成功的关键因素之一（表2）。通过视频中讲述的故事，与观众建立起一种情感联系，因此该方法与自己设计过程的相关性变得更容易理解。这揭示了说服因素和涉及人们应用方法的成功因素。此外，在视频中选择的例子展示了一个成功的故事，因此可以被看作是一种试验性项目，以说服工程师所提出的方法。视频很短，所以学习应用程序的时间变得更短。作为申请所需的唯一信息，收件人在该方法的应用中获得确认。通过主角面临问题的角度来讲述故事，将会有更高动机来对自己的类似问题使用该方法。总之，方法视频应该在动机、训练时间、应用中的各种方法、理解和教学和工业结果的质量等方面显示出额外的价值。

## **Discussion and Conclusion**

## **6.讨论与结论**

To answer the first of the previously defined research questions,it can be stated that the medium of video is well accepted in industry and education following the presented case studies.The question regarding the success factors for transferring (method) knowledge via videos was answered by deriving, in particular, the success factors storytelling, involving the recipient, combination of image and sound as well as lead by examples. So, some of the factors discussed in literature could be addressed. Furthermore, a better qualification of the user could be observed in the studies at the universities. However,most methods require a huge level of experience and knowledge. This experience may not be fully passed by an explanatory video and requires an instructor who is familiar with this experience and knowledge and has a great level of competence in the application of the method. Nevertheless,through the explanatory videos, the recipient received an overview and a basic understanding of the method in a short time. Additionally, the explanatory videos achieved a shortened training time as well as greater confidence in working with the methods. Nevertheless, to achieve these benefits, it is important to prepare a good method video. Besides giving an overview and a well-structured explanation, the main elements are simple illustrations and most notably a story with an exemplary application of the method. As an answer to the third research question, these elements were found essential within the presented case studies. In the future, there will be further effort spent to create more method videos to enrich the portfolio provided for design education and practice.

为了回答先前定义的研究的第一个问题，可以说，在所提供的案例研究之后，视频的媒介在工业和教育中被广泛接受。关于通过视频传送（方法）知识的成功因素的问题是通过推导的，特别是成功因素故事，涉及接收者，图像和声音的组合，以及通过实例引导。所以，可以解决文献中讨论的一些因素。此外，在大学的研究中可以观察到更好的用户条件。但是，大多数方法需要大量的经验和知识。这种体验可能没有完全被解释性视频所传递，并且需要一位熟悉这种经验和知识并且在该方法的应用方面具有很高能力的指导员。尽管如此，通过解释性视频，收件人在短时间内收到了对该方法的概述和基本理解。此外，解释性视频缩短了培训时间，并增强了使用这些方法的信心。尽管如此，为了获得这些好处，准备好方法视频很重要。除了给出一个概述和一个结构良好的解释之外，主要内容是简单的说明，最值得注意的是该方法的示例性应用。作为对第三个研究问题的回答，这些要素在所呈现的案例研究中被发现是必不可少的。未来，将进一步努力创造更多方法视频，为设计教育和实践提供更丰富的产品组合。