Individual Business Simulation Games as a Service: Towards a Concept for Adaptive ERP Education

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Abstract: Education Service Providers (ESP) are facing several challenges nowadays. They are under pressure on cost, to perform, and to innovate while meeting the different demands and requirements of their community. In Enterprise Resource Planning (ERP) education, Business Simulation Games (BSG) are a promising approach, but they are not used extensively yet for various reasons. With the development of a BSG as a Service concept, in which mass-customized games can be created according to the individual educators' needs, the attempt is to address the tension field of different demands. This provides opportunities for low-threshold, user-friendly, and tailored use. The paper at hand describes a generalizable concept idea by using an exemplary SAP-based use case. Modularization and recombination are probably the most important aspects of sustainable and adaptive ERP education for both meeting the different requirements of educators and making the challenges for ESPs manageable.

1 INTRODUCTION

"Worldwide IT spending is projected to total $5.1 trillion in 2024" (Gartner, Inc., 2023b). According to the authors, an increase of 8% from 2023 is expected despite the global economic slowdown. Especially the software and IT services segments are estimated to grow double-digit (13.8% and 10.4%) in 2024.

One possible reason is ubiquitous digitization in industry and society which often leads to organizational change processes known as digital transformation (Lang, 2022; Mertens et al., 2017). Therefore, companies have to use or adopt digital technologies and build software-centric operating models to take advantage of digitization and to make that challenging transformation process a success.

An example of intelligent software that digitizes companies' processes is an Enterprise Resource Planning (ERP) system (Sarferaz, 2023). In many fields and sectors, people with IT systems and process knowledge are obviously important, especially when using ERP systems. However, the number of job vacancies increases in many countries and at the same time, the shortage of skilled workers limits the growth of companies (Gartner, Inc., 2023a).

Consequently, there is a need for well-skilled graduates, lateral entrants, and in-house employees. Therefore, appropriate methods for knowledge transfer are required but there seem to be gaps in nowadays study course curricula (Kaiser et al., 2018). Besides, challenges in ERP education or training occure as well, e.g., finding suitable teaching methods, as well as maintaining ERP systems, and building practical exercises (Leyh, 2017). Concluding, there exists no gold standard but various requirements and didactic demands.

In ERP teaching, Education Service Providers (ESP) support lecturers and trainers (Prifti et al., 2017) by offering standardized teaching and learning environments (TLEs) consisting of a system, a model company, and teaching materials (Häusler and Bosse, 2018). Many educational institutions use those offerings to teach ERP concepts and demonstrate business processes (Leyh, 2017). TLEs are one of the key deliverables of the so-called Education as a Service (EaaS) model which is depicted in Figure 1.

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As the name already indicates, it is a service offering that is needed to transfer the technology, the knowledge, and the tools included in TLEs to educational institutions. In addition to the technical aspects, ESPs provide support and give instructions or insights how to use the TLE in teaching.

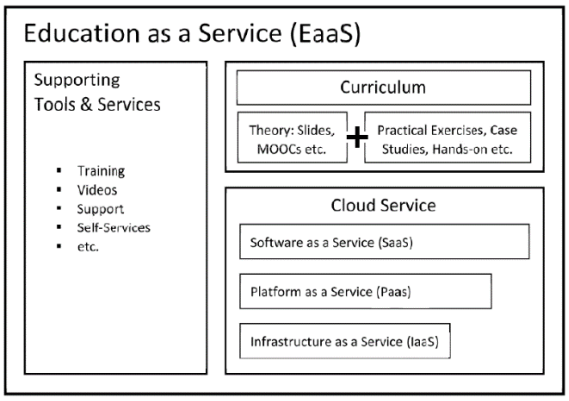

Figure 1: Key components of EaaS (Prifti et al., 2017).

As visualized, EaaS consists of three elements: Besides the essential access to software, platforms, or infrastructures (as a cloud service), curricula with theoretical and practical materials as well as supporting tools and services are provided. TLEs are not directly depicted in the figure but they would be in the pillars "Curriculum" and "Cloud Service".

In general, IT-related ESPs are facing several challenges nowadays. **(I)** The field in which they operate is subject to a naturally high level of dynamism since technologies are being further or even newly developed. **(II)** However, the process of creating teaching and learning environments is relatively complex and therefore costly. **(III)** ESPs are under pressure on cost, to perform, and to innovate. Looking at the needs and demands of the community, there are different requirements depending on the type of use, teaching objective, and user groups. **(IV)** Thus, there is a tension between standardization and flexibilization. **(V)** ESPs have to deal with didactic concepts in addition to technical knowledge, in which they are usually experts. For instance, in the field of ERP education, the case study method is prevailing until now (Leyh, 2017), but there are several problems in generating motivation and providing incentives (Häusler et al., 2021).

Addressing these issues and finding solutions is essential to enable learning success and produce well-equipped graduates. To do so, the use of learning environments in teaching can be crucial because they can have a positive impact on the quality of teaching and also lead to more efficient learning (Chang and Wills, 2015). Concluding, the use of TLEs is a prerequisite for learning success, but not necessarily leading to it. Furthermore, the construction of those environments according to the modular principle attempts to resolve the tension between standardization and flexibilization. This is done by splitting the TLE objects into small, standardized parts and combining them. The recombination of these parts provides for flexibilization, variability, and sustainability. The more segments there are, the greater the possibilities for combination and use. Regarding the motivational aspects (Weppel et al., 2012; Fischer et al., 2017) and interactivity (Lukita et al., 2017), the choice of an appropriate teaching method has obviously an impact on learning success as well and should therefore also be focused on.

A long-time underestimated approach in teaching and learning is the use of games (Wilkinson, 2016) which can stimulate intrinsic motivation and also generate a high level of engagement with the background information and knowledge (McGonigal, 2011). For instance, business simulation games (BSG) provide an excellent way to impart knowledge (Abt, 1987; Greco et al., 2013; Lainema, 2003). Not only processes and concepts can be taught, but also business backgrounds (Leyh, 2017). As a well-known and established BSG in the field of ERP systems, ERPsim proves this (Leyh, 2017; ERPsim Lab, 2024a; Hwang, 2018; Léger et al., 2010; Léger, 2006; Utesch et al., 2016). It consists of games for manufacturing, logistics, retail, and distribution with defined processes and determined products. According to their website, the use of ERPsim varies around the world. There are regions where the application is more concentrated than in others (ERPsim Lab, 2024b). Possible reasons are the licensing costs incurred (which are rather unusual for some countries) in addition to the system hosting fees, the limited number of scenarios, or the relatively high complexity of the single games.

In sum, this leads to the following thesis: BSGs are a promising tool or method for future teaching and learning. Moreover, especially a flexible BSG as a Service (BSGaaS) approach, in which mass-customized games are individualized according to educators' requirements, could address the described challenges. Modularization and recombination play an important role for the individuality and flexibility of teaching and learning. So, BSGaaS can be a crucial key part in this field to provide a sustainable success for both teachers and learners. Envisioning, if there is a large building block with different but freely selectable components, teachers would be enabled to compose games on their own (via self-service). In this

way, an individually customized learning setup can be created. Considering this concept as a part of EaaS, a flexible, cost-effective, scalable, and easily accessible usage of BSGs would be possible by providing cloud services. This results in the assumption that BSGs can be designed variably through an EaaS approach, offering the learners applications that can be used flexibly and personalized to meet the individual needs of the educational institution. The paper at hand describes the generalizable concept idea for adaptive ERP education using an SAP-based TLE and outlines one feasible solution approach. The gained flexibility including recombination and modularization support several stakeholders and helps meeting their demands and challenges in the process of transfering and dealing with knowledge.

2 THE USE CASE AND CONCEPT IDEA

To make this conceptual idea more tangible, an example shall serve this. The SAP University Competence Center (SAP UCC) Magdeburg operates as an ESP and is thus involved in various educational processes. Its main business is the development and operation of TLEs which includes hosting SAP solutions, making them worldwide available for academic purposes (Software as a Service), and creating a wide range of teaching materials (EaaS) with practical relevance in the field of enterprise software. The associated model company of many of their TLEs is Global Bike, a fictitious company that produces and sells bicycles.

As part of the related academic community, the SAP UCC works to improve existing services and offerings and tries to integrate alternative or innovative teaching and learning concepts. In particular, the SAP UCC decided to enhance the "Introduction to SAP S/4HANA" TLE by BSGs in order to address additional learning objectives (Anderson and Krathwohl, 2021) and increase motivation. Within two pilot development projects, a team of four persons already developed "Global Bike Go", a three-part series of turn-based, modular BSGs in a beta version so far (Häusler, 2019). They are designed as mini-games lasting between 45 and 90 minutes while each pursues small and simple learning objectives (understanding simple market mechanisms) in the corresponding module context, described as follows.

- **Explore Procurement:**
  Purchasing optimization (supplier selection) based on offered product combinations, price, and delivery reliability.
- **Explore Production:**
  Cost-efficient fulfilment of a given production target under certain conditions (number of working days, number of employees, product costs).
- **Explore Sales:**
  Maximizing profit through bicycle sales by setting the selling price, considering the market, and seasonal influences.

In these games, the players act as part of a department but due to the simple scenarios and the limited number of decisions (1 or 2 per round), role-based gameplay was not intended so far. Figure 2 illustrates the general game structure and a fundamental principle for the concept idea.

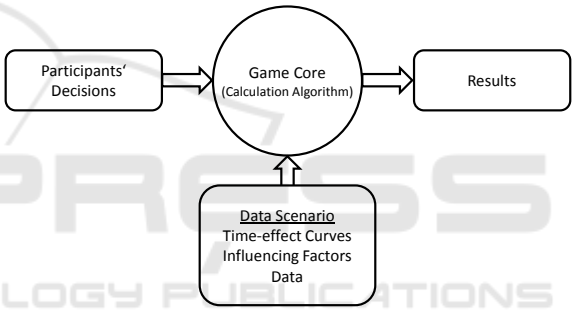

Figure 2: Separation of game core, data scenario, and decision data (Kern, 2003).

As can be seen in the figure, the game core calculates the results from the participants' decisions, considering the data scenario (including time-effect curves, influencing factors, data). Although these individual components are related to each other, they are implemented and stored separately. This is in accordance with Kern (2003) who postulates exactly this separation of core and data scenario as a prerequisite for making simulation games more flexible.

The main idea of BSGaaS will be illustrated by the Global Bike Go example. The hitherto developed games are modular and do not yet have any dependencies on each other but have been designed in such a way that they can be prospectively combined in a building block approach (modularization and recombination). Figure 3 illustrates the concept idea. Due to this flexible

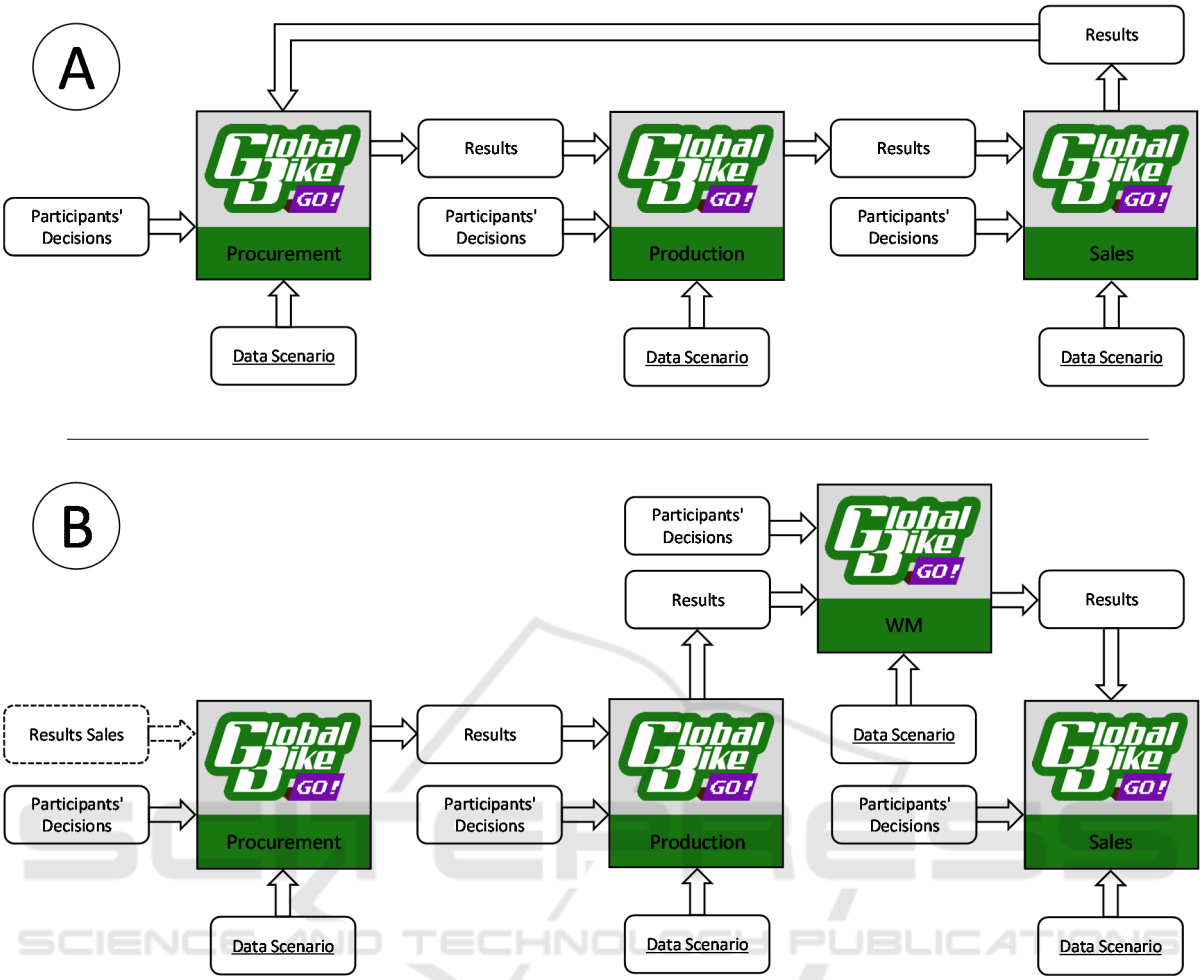

Figure 3: Schematic representation of possible future combinability and extendability.

design, the TLE is highly adaptable and supports the individual demands.

As depicted in the upper area **(A)**, the games can be combined with each other and thus the single "departments" are brought together. The results of one game serve as input factors for the respective following game, e.g., the output of procurement is the input of production, or the output of production is the input of sales. In this way, further modules can be integrated as shown in the bottom area of the figure **(B)**.

For example, a warehouse management (WM) component could be placed between production and sales, or a human resources component could influence the whole order-to-cash process. However, not all departments would necessarily have to be managed by players, since some module decisions could be simulated by the system (depending on the lecturers' choice).

If the market or simulation model is integrated separately from the organizational and process data (as Figure 2 indicates), it could be relatively easily changed, e.g., sustainability could serve as goal instead of profit maximization in the Explore Sales game. The input parameter (e.g., participants set selling prices) remains the same. As needed, time-effect curves, underlying data, the general calculation logic, or other factors can also be changed to vary the output (the number of bikes sold) depending on the desired learning objective. By the separation of core and data scenario as depicted, organizational units, processes, or master data (other products e.g., cars instead of bicycles, other customers, etc.) can be exchanged or extended which is advantageous for the individual BSGaaS approach.

In general, the variable combination of BSGs (permutations) enables the individualized and flexible design of teaching and learning content. Individually, the games focus on their origin scenarios' objectives, whereas the combination enables new and integrated learning objectives. The

integrative character could also bring role-play into focus.

Thus, teachers and learners can create or enrich their own TLEs according to their needs. In the future, further processes can be configured in the system, or processes already preconfigured for the model company can be developed as game parts. Each individual process within a functional business module or the integration of additional modules not only creates a potentially further business game but also expands the possible combinations. The result is a mesh of BSGs in relation to the existing model company.

With each change and extension, the pool of possibilities becomes larger. With the help of the building block principle, the small, standardized parts can be (re-)combined relatively flexibly which provides variabilization. Thus, despite the standardization (a large, general, non-specific pool), there is the possibility of customization to fulfil different demands exactly. With this approach, small new modules can be created faster and easier. The smaller units also allow for faster error correction and incorporation from reflection and feedback processes. These aspects keep costs lower while enabling dynamism. In this way, both standardization and flexibility find their way into the process. Another possible advantage is that the development of individual components can also be outsourced to experts in the user community, e.g., special market or simulation models, aligned with their personal learning objectives. An open-source approach for further dynamics is also conceivable and implementable in this way.

However, the specific game realization depends on the concrete use cases and the particular functional requirements (Häusler et al., 2021). As already explained, different stakeholders have different needs. The two main stakeholders ESP and users (teachers and learners) of the games have the greatest influence on the design and requirements that need to be considered. Their influence results from economic aspects (time and cost efficiency in the creation of teaching materials, sales coverage, selling price) and from the inherence approach (create and use best possible products). Generic requirements for games from the users' perspective have already been started to be investigated (Häusler et al., 2021). But what does it look like from the perspective of ESPs? Considering the challenges for ESPs (cf. Section 1), the following aspects are identified:

- Cost-efficiency
- Diverse offering to reach many teachers and learners (as they are their customers)
- An effective and efficient approach for variabilization
- Time-saving development and adaption
- Easy maintenance, hosting, and operation

Looking at the demands of both ESPs and users, a field of tension emerges. The following (future) research questions stake this out and enable an approach and solution-oriented treatment of the field in the following steps:

How can BSGs be efficiently created, deployed, and operated? How can BSGs be designed configurable or created flexibly? Which components are required for BSGs and which of them play a decisive role in the BSGaaS approach? Finally, which components can be variabilized?

3 COMPONENTS AS KEY

To address the aforementioned questions with regard to modularization and recombination, components are a central, promising and therefore unavoidable aspect of a solution approach. Models like the so-called shell model by Kern (2003) serve as a basis and provide important findings.

Using the term Net-based Business Game Learning Arrangements (German: "Netzbasierte Planspiel-Lernarrangements", short: NPL), Kern proposes the shell model to structure different components and to derive requirements as well as design recommendations for learning environments and user groups. Various technical possibilities for an NPL architecture are also discussed. However, the technical aspects will not be part of this work so far. Figure 4 below shows the components of the NPL shell model.

As depicted, the game core and the data, which are in the center, are essential for web-based business games. The core includes the calculation algorithm or simulation model as already presented in Section 2. Representing the second shell, the graphical user interface (GUI) enables the users to access the core's functionalities. Depending on the needs and tasks, different and individualized GUIs can be provided per user group. Logically, the GUIs of game masters and participants differ in design and functionality.

The outer shell contains components that belong to the overall learning arrangement but not directly to the game itself. These include:

- The communication and cooperation components for the interaction between the participants,

- Decision support tools for participants (e.g., for planning or for analysis),
- Support components for the game master (e.g., additional information, opportunities for (de-)briefing, assistance in running the simulation), and
- Teaching as well as practice modules (e.g., facts to be taught in advance or methodological knowledge).

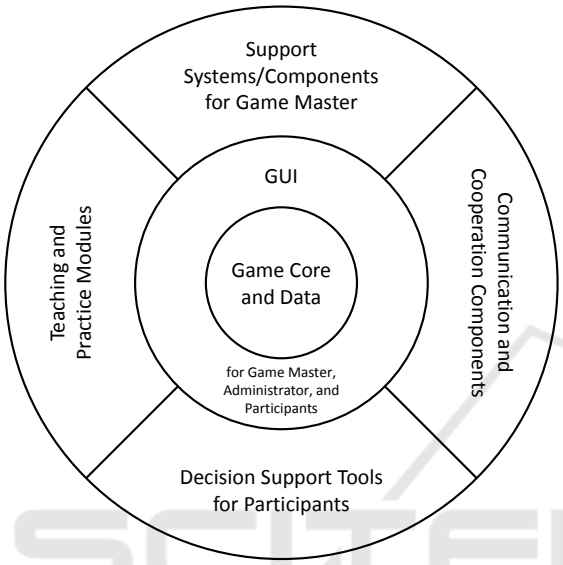

Figure 4: Components of the NPL shell model according to Kern (2003), translated.

While the outer shell components do not necessarily need to be provided for playing the game itself, they are nevertheless essential in an EaaS and also in a BSGaaS (cf. Figure 1) approach to create the prerequisite for a good game experience for game masters and participants. They serve as supporting tools and accompany the entire game sequence. Especially in online courses (such as during the peak phases of the COVID-19 pandemic), communication and cooperation components are indispensable to enable players' collaboration. Additionally, since the games are not designed by the lecturers, it is the ESPs' responsibility to instruct them appropriately. This applies to all game phases (preparation, execution, and evaluation).

As can be derived, Kern's model provides a solid and expandable basis but comprises only general components on the meta-level. Therefore, further investigations as well as a scientific deepening are necessary. First, it is important to identify all the required components. In the context of the BSGaaS concept, it is a fundamental question of how the components can be variabilized (in the sense of modifying parameters and variables). Especially regarding the (re-)combination of components, this is a crucial aspect. A subsequent question is how variable the components of a BSG can be without changing the core concept of the game.

Concerning this variabilization, attributes or classification characteristics such as those of Kern (2003) and taxonomies such as those of Greco et al. (2013) could serve this purpose. They provide, besides a classification, also implicit but logical variabilization possibilities for components in the BSGaaS approach. Some examples from Greco's taxonomy are:

- Characteristics of users' decisions (qualitative, quantitative),
- Transparency of the simulation model (black box, grey box, transparent box),
- Model behavior (deterministic, stochastic),
- Influence of external data (with influences, without influences),
- GUI type (browser-based, mobile-based, software-based, not digital),
- Player Composition (single player, single team, multi players, multi team, massive),
- Role playing (yes, no), and
- Debriefing options (collective, individual, absent).

Those attributes or characteristics need to be assigned to the single components. When the characteristics are determined, they shape the different game instances. This could implicitly enable a cost estimate for the ESPs. It is presumable that additional characteristics or whole components will initially be more expensive to develop but – if the BSGaaS is reasonable realized – the larger the component base becomes the more cost-effective it will be in the future.

4 CONCLUSION AND NEXT STEPS

Overall, the following first findings can be derived. Modularization and (re-)combination are probably the most important aspects of sustainable and adaptive ERP education for both meeting the different requirements of educators and making the challenges for ESPs manageable. A separation of game logic and data concept ensures "scalable complexity" (Kern, 2003) and thus guarantees flexibility as well as user-friendliness. Innovative concepts and general scalability are essential for an ESP to be able to offer

products on a large scale and thus to be broadly positioned and stay competitive.

The primary goal of the overall research is to develop a rough design for BSGaaS in the ERP environment, in which it is necessary to vary the components of the business game. For this purpose, the BSG components, which can be optimized or even flexibly designed according to the teaching and learning requirements, have to be identified.

As already motivated, the current limitations have to be overcome by creating variable use cases, and versatile learning settings. The differentiation of stakeholders such as developers and users is important, while the inclusion of all requirements within the BSGaaS approach is essential. The teaching requirements for business games are therefore a primary part of the analysis and must be identified in the course of further work. Business games that can be configured and personalized according to the users' needs without much effort enable a free and focused engagement with the learning content. The users are dependent on ESP Supporting Tools and Services when using the games in teaching since they do not develop the games themselves. In this context, a decisive question will be how materials for teachers, e.g., with ideas and approaches for (de-)briefings or instructions (EaaS), can be flexibly created, easy to use, and made available.

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