The BIM Challenge:  
A Gamified Framework for Learning Revit to Achieve a BIM Process

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Learning Objectives
Discover how to deal with training in a way that goes beyond the classroom and into the practice  
Learn how to apply game-design techniques to Revit training  
Learn how to set up a gamified pathway to knowledge and scale it down (or up) based on needs  
Learn team management skills through a practical experience

Description
Transitioning from a traditional workflow to a Building Information Modeling (BIM) process is a challenge—a challenge that requires problem solving, constant training, lateral thinking, skill developing, and lots of practice. There are many ways to spread this kind of knowledge, and a traditional approach may not be the more successful. Through the principles of L-D-A (lecture—demo—action) and game design techniques, this class will explore a different approach to teaching BIM through the gamification of a pathway that leads from the old ways of working to the new practice. This is suitable not only for architects, but also for owners and operators who want to approach the subject of BIM through an engaging, effective way.
Speakers

Chiara C. Rizzarda
Currently Deputy BIM manager for Antonio Citterio Patricia Viel, the leading architectural firm in Italy when it comes to BIM, Chiara started working as interior designer and construction site surveyor. She worked on projects basking in historical heritage around Europe and Middle-East and worked for years as a BIM Coordinator in Milan, where she lives. She’s an Autodesk Certified Instructor, currently giving lectures and teaching Revit in northern Italy, she sits at the table for the development of the Italian norm on BIM, she’s co-founder of the Italian BIM User Group and is the proud co-creator of the one and only drinking game for BIM summits. In 2016 she published “The BIM Challenge”, a book in three parts about approaching Building Information Modelling in a design firm.

Claudio Vittori Antisari
Claudio is an Architect specialized in BIM and Computational Design, currently working as Bim Manager at Antonio Citterio Patricia Viel, a BIM leading architectural firm based in Milan, Italy. From 2009, he has been part of a BIM and Computational Design pioneer group in the RomaTre University under Professor Stefano Converso. During his last 8 years of experience, he has had the opportunity to work in different BIM roles in different world areas, from BIM researcher to BIM consultant up to BIM manager. This exposure has given him a deep understanding of the BIM process for architectural offices. Nowadays he spends most of his time helping architects to improve efficiency and effectiveness in building design. He participates actively in the BIM national and international debate, taking part in BIM-related events and conferences, participating in university research groups, and providing consultancy to governance projects.

Gabriele Gallo
Gabriele Gallo studied History at the University of Turin and worked for five years as a site surveyor and accountant for the construction industry. Right before his thirties he gave studies another shot and entered the Event Horizon School of Digital Art. There he graduated with an insane obsession for the design similarities between games and architecture, specializing in the gamification of educational processes. The madness in his eyes was there well before that.

As a student he worked as Quality Assurance for the couch multiplayer Hyperdrive Massacre (2015 pc Steam) and the futuristic racing Redout (2016 pc Steam, 2017 XBOX, Playstation) for Turin’s indie developer 34 BigThings. He’s currently the Lead Designer in Event Horizon Studios and alternates between video games production, teaching and tutoring Design courses. With the Studios he published the arcade mobile Pulse (2016 Android & iOS) and the turn based tactics Goblin Squad (2017 pc Steam). He worked on the game design aspects of Chiara’s “The BIM Challenge”, a book in three parts about approaching Building Information Modelling in a design firm. He plays, solves problems and loves doing that.
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1. The Slow Revolution of BIM

The Term Revolution stands for a “dramatic change in the way a country is governed, usually to a different political system and often using violence or war” according to the Cambridge Dictionary. In History it has been used often in contrast with the term Revolt.

The main difference between the two terms is inside the idea that during a revolt the rioters aren’t aiming to completely upset the political system, but just to implement some changes, to increase the advantages of a specific party or group. A revolt can spell disaster to the actual government system and breeds resentment for the actual rulers, but the system would not be turned upside down.

Instead the basic concept of a Revolution is to turn the system upside down. The main goal is to make a dramatic change in the governance and to impose a new system based on completely different rules. A Revolution is a change of paradigm, a Revolt is more an adjustment of the existing one.

Aiming to overthrow the king and install a completely different form a government: definitely a Revolution.
In BIM, the term “Slow Revolution” is mentioned from time to time. It’s often used to describe the transformation the AEC industry has undergone in the last two decades with the relentless adoption of digital technologies and processes, often coming from more technologically advanced fields. This migration of tools and techniques is setting the wheels in motion, for the next imminent Revolution, the building information modelling. It isn’t a fast approach and the construction industry is changing imperceptibly day by day, but if you look at this process from a broader point of view it is clear that sweeping changes have been implemented over the years.

So why do we choose the term Revolution? Because the coexistence of the CAD based systems with those more technologically advanced is nearly impossible. As soon as the majority of professionals move with the times and adapt to BIM, there will be a dramatic shift and no more space for CAD. We are far from feeling the full effect, and many sectors are still unsure about the transition, but the road ahead is clear.

In the details, the term Revolution remains accurate because the new processes are based on different criteria from the previous one. It is difficult to believe in a CAD-BIM system coexistence, as soon that Building Information Modelling reaches full maturity in terms of adoption.

And of course also the term slow fits in well: It has been a long process, and we are far from seeing the end of it.

Training the AEC Manpower to BIM is, without any doubt, one of the cornerstones to reach the full maturity and at the same time one of the most critical activities to perform. **This class will focus on conventional and less conventional training techniques.**

The challenge consists in developing a series of tailored training approaches to really a large number of individuals, organizations, processes and technologies at all levels. Starting from the idea that a single training method will never produce the results we are all hoping for, we need to start to break down several topics. We need to **identify what is competency in BIM** for the different roles. Then we need to **take a look at the different training approaches** starting from the most dated one to the most innovative ones, to find the ones that are best adapting to the changing circumstances.

**2. Individual BIM Competency**

Finding the best training approach in AEC field, is not an easy task. It’s clear that a single training approach will not fit with the needs of a huge industry, and several different ones are needed in order to generate a portfolio of training techniques.

To begin to tackle the best training approach we need to navigate between a variety of notions and concepts coming from different fields: training, building information modelling, and construction to say the least.

The first concept is to identify what are the need skills to become proficient in BIM. We have to renounce the existing idea, and start considering that proficiency in BIM comes from a framework of different skills.
Clarifying the competencies needed to be proficient in BIM will empower us to consolidate our understanding and help us to customize the best training approach.

We don’t have to start from scratch, because we can take advantage of many frameworks already used for our field.

2.1. The BIM Thinkspace Theory

We consider the BIM thinkspace blog (http://www.bimthinkspace.com) by Bilal Succar as one of the best resources for theoretical and practical knowledge about building information modelling. The blog is organized in episodes, each one tackling a different topic. In particular, the Episode 17 is dedicated to breaking down into measurable concepts the complex topic of Individual BIM Competencies.

Individual BIM Competencies are the knowledge, skill and personal traits required to generate model-based deliverables which (a) can be measured against performance standards, and which can be acquired or improved via education, training and/or development. (from http://www.bimthinkspace.com)

According to the Bilal Succar Matrix, there are four base competencies and another four composed by the combination of them. The first four competencies are Managerial, Functional, Technical and Supportive.
Managerial Competency refers to “the decision-making abilities which drive the selection/adoption of long-term strategies and initiatives”. Functional Competency is “the non-technical, overall abilities needed to initiate, manage and deliver projects”. The Technical Competency is “the individual abilities needed to generate project deliverables across disciplines and specialities”. And lastly, Supportive Competencies: “These Competencies are the abilities needed to maintain information technology and communication systems”.

Those base competencies combined together create other four: Research and Development, Implementation, Operation and Administration.

These competencies do not relate directly to Job Titles, like BIM Manager or BIM Coordinator, as they are cross competencies for all the roles in the BIM Industry. You don’t have to excel in all of them to be successful in a particular role or be great in all of them, to be successful in a particular role. A great model manager can be a mediocre trainer and a great trainer may not perform well in an operational role.

The Matrix is doing a great job in consolidating the idea competencies and it differs for individuals and different roles. How do we generate a training approach for all of them, how do we simulate all the possible scenarios where these competencies are needed in order to save the day?

Let’s bring into the game a similar but simpler matrix. It will give some additional tools that will help us to turn our attention in the right direction when we start to address training as a topic.

### 2.2. The Italian BIM User Group Approach

The BIM Framework approach is one of the most exhaustive, complex and deep of most of the theoretical and also practical topics about Building Information Modelling. It’s the perfect source of knowledge for a very skilled and motivated individual. Complexity is its strength, but also may be a weakness, when it comes to communicate the concepts to a broader audience. Sometimes to communicate a complex concept, a simpler version is needed to work as trojan horse to create space and interest about the much complex one.

For this reason the Italian BIM User Group (BUG) has decided to develop a simpler version of the individual competencies concept. The BUG theory is voluntarily simpler, aiming to bring a less adept audience closer to the topic, in an easier way.

According to BUG, proficiency in BIM in (almost) any roles of the AEC Industry, can be reduced to two factors: knowledge of instruments and knowledge of processes.

These two are both critical factors, without deep knowledge in both of them it’s impossible to be considered an expert.
To sum it up, competency in BIM consists of competency in using the instruments and competency in controlling processes.

Knowledge in processes can teach you what are the most relevant goals and tasks to perform in a building design process; On the other hand, knowledge in instruments is needed in order to be able to achieve those goals, in the most efficient way. Building Information Modelling is a process based on the usage of softwares. It's impossible to do BIM without software knowledge.

The usage of Building Information Modelling has begun in different industry fields, like the automotive and aerospace industry. These fields are characterized by the presence of a few big companies that manage the majority of the process. This limited number of actors has contributed significantly to reduce the proliferation of a large number of processes and tools.
The Boeing Production Line: one of the first places where the usage of digital processes and tools took place

This scenario turns upside down when we move in the direction of the AEC Industry, due to the fractured state of the industry itself. In the last two decades we have seen the rise of hundreds of tools and processes to satisfy all the needs in the building process. The general principles remain unchanged, but its application has drastically changed. Let’s be ready to face a high variety of processes and tools.

Processes differ in the various areas of the Building Industry. They can change in different phases of a project and in different disciplines. This affects the Individual BIM proficiency: for instance, being an expert in BIM for architectural design does not automatically make you proficient in BIM for MEP. Moreover, even in the same discipline, being an expert in BIM for conceptual design doesn’t mean that you can manage with the same ease the tender or the construction phase. You may experience the same challenges if you move in a different part of the world. Due to several factors the same task can be executed in very different manners in two different world areas. It is undeniable, on the other hand, that being an expert in one discipline or one specific sector gives a good advantage in transitioning into an adjacent zone. It will still take time and it isn’t an automatic transition.

Also, a deep knowledge in processes can’t be considered enough to be proficient in BIM.

Building Information Modelling is a process that takes advantage of a large variety of digital instruments. Again without instruments it’s not BIM anymore. There are hundreds of BIM tools, and it’s impossible to define a precise number because of their rapid proliferation. There isn’t just one recommended tool for any task, and many goals can be reached following different roads.
Mastering a BIM software doesn’t make you automatically an expert into another one. Let’s take for instance Revit and Archicad: they both serve the same scope, but knowing one is not enough to be considered an expert in the other. However, because some concepts are similar, being an expert of one of the two should speed up the learning process of the second.

Going along with the idea that proficiency in BIM is determined by these two factors, processes and instruments, and that is impossible to measure this proficiency without applying it on a specific job or sector, we should start asking ourselves how do we train people to reach this proficiency.

There is a great challenge to tackle: is it possible to develop a training approach that can be based both on general principles and be effective and adaptable in any scenario? Moreover, if we define proficiency in BIM as a mix of Processes and Instruments skills, how do we teach both topics? Can they be taught with a similar learning framework? The differences between them suggests that a better option would be to navigate through different training approaches to find the best one for this task.

This bring us to the next question: how do we train people? In the last one hundred years we saw several training techniques that were introduced. Without a deeper understanding of those it is impossible to answer the above questions.
3. How do you normally teach

3.1. Andragogy vs pedagogy: adults and learning
Methods and principles used in adult education are radically different than the ones we use to teach the young. The motivation is different, context and aims are different, and all these differences require a drastically different framework.

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<thead>
<tr>
<th></th>
<th>with Adults</th>
<th>with Children</th>
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</thead>
<tbody>
<tr>
<td>direction</td>
<td>self-directed learning</td>
<td>strong leadership</td>
</tr>
<tr>
<td>experience</td>
<td>needs to be a basis for further learning</td>
<td>is scarce by nature</td>
</tr>
<tr>
<td>programmes</td>
<td>learning programmes are shaped on actual needs of everyday life</td>
<td>learning programmes are theoretically based on social needs</td>
</tr>
<tr>
<td>aims</td>
<td>knowledge in order to perform tasks</td>
<td>knowledge for the sake of knowledge</td>
</tr>
<tr>
<td>motivation</td>
<td>internal motivation</td>
<td>external pressure</td>
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Oddly enough, often instruments remain the same: traditional education for children relies on textbooks, frontal lectures and exercises just as much as adult education.
Whilst the science of teaching to children is called Pedagogy, another term was coined during the 70s to refer to techniques and methods used with adults: the term is Andragogy and was rendered famous by American educator Malcolm Knowles¹.

Malcolm Shepherd Knowles (August 24, 1913 – November 27, 1997)

3.1.1. Malcolm Knowles and the basic principles
Within his theories concerning andragogy, Knowles came to identify certain basic principles particularly important for motivating and inspiring adults to learn.

The number of these principles varies within his writings. Certain aspects however remain the same throughout his production and are still used today as a basis for teaching adults².

1. Relevance. Adults are interested in learning subjects that have immediate importance to their job or personal life. This is one of the main reasons to avoid generalistic training:

¹ Although Malcolm Knowles is credited for giving resonance to the term, and although he claims it was presented to him by Yugoslavian educator Dusan Savicevic in 1967, the term was actually coined in 1833 by Alexander Kapp, a German educator.
² For further reference:
Kearsley, G. 2017. The Theory Into Practice Database.
Retrieved from http://InstructionalDesign.org
the needs of students are to be carefully assessed and a tailored offer needs to be provided in order for them to respond in a positive way. No matter how interesting a theoretical subject might be: adults will approach it only if they feel it has an impact on their personal life.

2. **Problem-solving.** As a consequence of the previous point, adult learning is problem-centered rather than content-oriented: the same subject has more appeal when presented with its immediate practical application as its relevance is reinforced.

3. **Planning and Evaluation.** Adults feel the need to be treated as equals by their instructor and they respond very well when they have an active part in the shaping of their learning path. Flexible programmes are preferable, with multiple choices available to reach the same goal, also because learners with the same goal might have different preferences about the means of learning (reading vs. listening is the simplest example to grasp this concept). Also, they need to have tangible goals with clear means of evaluation, so that they can be self-aware of their progress and level.

4. **Experience.** While children approach learning inexperienced with regards to the topic at hand, adults have a different approach: even if they have zero experience when it comes down to the specific topic, they feel the need to bring something to the table and to be considered more than empty canvases. Also, application (including error) provides the basis for each learning activity and helps to counteract the Knowledge Retention Curve (better known as the Forgetting Curve).

![The Forgetting Curve according to Hermann Ebbinghaus (1885)](image_url)
3.1.2. Hermann Ebbinghaus and the forgetting curve

In 1885, German psychologist Hermann Ebbinghaus was pioneer of the experimental study of memory through a series of experiments on himself. They aimed at demonstrating the exponential nature of a particular kind of memory loss, especially on notions freshly learned and in absence of immediate application.

His formula is roughly shaped like this:

\[ R = e^{-\frac{t}{s}} \]

R being memory retention;
\( t \) being time;
S being the relative strength of memory.

This particular kind of memory loss is called transience, the process of forgetting that occurs with the passage of time, and is just one of the seven kinds of memory loss.

Ebbinghaus’ experiments concerned the memory retention of a series of nonsense syllables and went down to demonstrate that transience is worse if there is no immediate application of the notion.

On the other hand, if there’s an immediate application of the notion the transience curve gets less and less steep, meaning it takes increasingly more and more time to forget what has been learned.
Fighting the Forgetting Curve: immediate application helps in counteracting memory loss

This led to different techniques of incorporating immediate application in lessons destined to adults.

3.2. The L-D-A learning cycle
«Not having heard something is not as good as having heard it; having heard it is not as good as having seen it; having seen it is not as good as knowing it; knowing it is not as good as putting it into practice.»

(Liu Xiang in The Teachings of the Ru, translation by John Knoblock)

In order to provide a more solid format of teaching, based on the concept that people learn from experience, educational reformers such as John Dewey developed the concept of a “learning cycle”, a sequence of phases throughout which it’s assured that the learner will be engaged, self-aware and will retain the highest amount possible of notions through their immediate application.

Amongst the several schemes for a learning cycle, a very popular one is the L-D-A format, also encouraged by Autodesk in their Certified Instructor program.

The cycle consists of three steps:

- **Lecture**, a theoretical part where the instructor provides the framework of concepts necessary to understand;
- **Demo**, in which the instructor himself showcases a practical application of the concepts above described;
- **Activity**, in which students are required to carry out the same activity in an autonomous way.

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3 John Dewey (October 20, 1859 – June 1, 1952) was an American philosopher, psychologist and educational reformer.

4 For reference, see [http://aci.autodesk.com/](http://aci.autodesk.com/)
A typical learning cycle in three steps, which works very well in Software training

Each phase of a learning cycle is to be seen as a cog in a mechanism and needs to be connected with the previous and the following. As we will see, there is no topic that can’t take advantage of this approach.

3.2.1. Lecture Phase

The lecture phase is the theoric phase of a training session and usually includes an introduction to the topic, which also serves as a catch to captivate the attention and set the tone, and a moment in which the learning objectives are clearly stated and set.

At an equal level of importance, this is the phase where you provide background information on the subject, the needed context.

In Software Training, this phase is often overlooked, as technical training is seen simply as a sequence of demonstrations and applications for commands and inputs. This couldn’t be more wrong.

three elements of a Lecture phase
Let’s take as an example a lesson about how to make parametric families in Revit.

You could start your lecture phase straight by introducing technical concepts and talking about loadable vs system families, type vs instance, parameters.

As an alternative, you could take a step back and explain why as designers we feel the need of making parametric objects and where lies the root for the concept of “type”. It’s a journey that might take you back to Vitruvius and Leon Battista Alberti, both of whom described classical columns by identifying the mathematical rules and formulas underlying classical proportions.
A later illustration showing the mathematical proportions of a classical column as described by Leon Battista Alberti

Their procedural algorithms are an excellent example of a parametric approach to architecture and will help you stressing few important points such as:
• the tool (Revit) responds directly to an actual need of designers and not the other way around;
• the concept of “parameter” has been an everyday concept since the earlier times in the history of architectural design and is far from being limited to software;
• a flexible family without mathematical constraints to parameters is a half-done family.

3.2.2. Demo Phase
The subsequent phase, once the theoretical background has been set and context has been correctly provided, is a demonstration. The more practical, the better. It can be a showcase of practical situations or an actual live real-time demonstration. This is a very popular phase in software training, but an often neglected one when it comes down to teaching the process.

As an example, while teaching the same class about Revit families the Demo Phase will be the instructor showing the very first step, opening himself a template for a new family, placing reference planes, giving them the correct name and assigning them the correct properties. The time span of this phase can vary but shouldn’t be too long as people will have trouble retaining what they are seeing. It’s crucial that their attention is completely on the instructor and on taking notes: the learning cycle bases its strength on the rigid division of phases, therefore no practical activity on behalf of students is to take place in this phase.

3.2.3. Activity Phase
A crucial third phase is the one in which the instructor relinquishes control and the student is up, on his own, to repeat what he saw and apply what he learned. In a classroom, especially while teaching software, this phase occupies about half of the time of a learning cycle and is carried out within the classroom itself.
This phase consolidates learning: it has the highest importance and should not be overlooked.

In the previous example, this would be the time for students to start creating a family themselves, repeating the steps they have seen taken by the instructor.

When this cycle takes place into an actual classroom, it’s easy for the instructor to pace around and monitor how the activity is going, although it would take additional tools to provide a punctual feedback.

More difficult is to provide this kind of feedback when the learning takes place in different environments rather than a classroom: this might call for tools of self-evaluation, as the instructor might not be present at all times. On the other hand, as we have seen, adults need in any case the means to self-evaluate their progress, so these kind of instruments might prove useful anyway.

3.3. Challenges of applying this model to teaching the process

As we have seen, the first step of this 3-step cycle might prove more challenging when teaching proficiency with instruments, while the second and the third are more difficult to apply when teaching the process.

The so-called “case studies” are an excellent example for the principles of a demo applied to teaching the process: they showcase actual application of the theoretical principles and, when done correctly, provide step-by-step insights on how the general principles can be applied.

So far, so good: we are seeing that the L-D-A scheme is applicable also to teaching the process. As we will see, the criticalities arise in the Activity Phase.

3.3.1. Activity Phase
Theoretically, the activity phase shouldn’t be so difficult in itself. Teaching the process is not about teaching principles that will stay in the realm of theory, but those principles will have to be applied in practice and the case studies in the demo phase are examples of practical applications.
However, those practical applications differ from what the students will be required to carry out in one significant detail: those were applications of real life, and a training session relies on simulated situations.

As an example, when teaching training techniques, practical activities are often carried out in a simulated classroom, where the trainers and the other trainees all play the part of students in turns so that everybody can experiment with the training techniques. Lots of training programmes rely on workshops with simulated activities in order to provide the third phase of the learning cycle, from Project Management to Teaching courses. This kind of activity is called “mimetic” and has both strengths and limitations.

<table>
<thead>
<tr>
<th>“mimetic” activity</th>
<th>Strengths</th>
<th>Limitations</th>
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<td>(an activity that simulates the same exact activity the student will be required to carry out in real life)</td>
<td>It puts the learner in the exact activity he will have to learn to perform</td>
<td>It doesn’t provide tools for each situation, as it simulates just one possible scenario: it creates a rigid framework where concepts are blindly applied</td>
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<tr>
<td></td>
<td>It allows mistakes without actual consequence</td>
<td>There might be a system to highlight mistakes, but they often don’t get reinforced by showing even a simulated consequence</td>
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<td></td>
<td>The protected environment allows a complete focus on the activity</td>
<td>There is little emotional involvement</td>
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The main disadvantages of a mimetic activity can summed up in three points:

- it’s not compelling;
- it’s rigid;
- mistakes are monitored but there’s no appreciation of their consequences.

In order to face these disadvantages, and from the awareness that mimetic activities are not enough, in the early years of this millennium some educational institutions massively turned to gaming in order to improve the activities connected to their learning programmes. Particularly significant is the work of what has been called The Educational Arcade of the Massachusetts Institute of Technology: the division designs educational tools «with the educator in mind» and uses «technology to create powerful learning environments in schools, in the home and in the community». In one of their first papers “Moving Learning Games forward”, they state that «game players regularly exhibit
persistence, risk-taking, attention to detail and problem solving skills, all behaviors that ideally would be regularly demonstrated in school. Some of the benefits of using game environments for learning are outlined as such:

- They enable players to construct understanding actively;
- They empower learners with the tools to learn at their own individual pace;
- They enable players to advance on different paths at different rates in response to each player’s interests and abilities;
- They promote collaboration;
- They encourage just-in-time learning as opposed to generic non-applied notionistic learning.

<table>
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<th>construct understanding actively</th>
<th>adapt to individual paces</th>
<th>advance on different paths</th>
<th>promote collaboration</th>
<th>encourage just-in-time learning</th>
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In their last publication, “Moving Learning Games Forward”, they identify five degrees of freedom achieved by the concept of playing. They are:

- freedom to fail;
- freedom to experiment;
- freedom to fashion identities;
- freedom of effort;
- freedom of interpretation.

The first two are particularly important when it comes to teaching the process, as it’s a freedom one will rarely be allowed outside the training environment.
3.4. The Limits of Training

As we will see in this handout the gamification process and game design techniques can highly increase the effectiveness of the Activity phase, regarding the training professional and the process. At this stage we have the duty to draw a line also in the opposite direction: there a limit in training that is impossible to overcome.

In the Building Information Modelling Job Market, to apply for most of the Senior Positions they require a remarkable amount of years of practical experience. A Senior Bim Manager position in large company, for instance, will usually require the candidate to have at least 10 years of experience in a similar company and field. In addition you will have to demonstrate to be proficient in several softwares too, but experience with tools alone doesn’t qualify for that position.

If we break down this concept we see that the market doesn’t really believe about the possibility of learning the process in a different way than the practical experience. Spending several years in the field gives a practical experience that allows you to become an expert. Theoric knowledge will never be enough to become an expert in BIM. Experience means having seen a lot of different scenarios during the years, which provides an improved ability to manage every unforeseen request. The construction industry is a fragmented market with a large variety of workflow and processes. Having experienced a lot of them is a strict requirement to be considered an Expert.

In setting up a training approach for professionals, it’s important to keep in mind that there is a limit to the amount of proficiency you can gain from straight training. There is a ceiling that you can’t go above. The Individual Competency Index (ICI) one of the many tools created by Bilal Succar that helps us to visualize the limits of training: expertise requires a mix of theoretical knowledge and it’s repetition in time in the field.

![Individual Competency Index (ICI) by the BIM Framework Blog](image)
Even the best training program can’t produce experts out of the box. Actually the reach of an intermediate level of proficiency is the result of a very effective training, and most of them just provide a basic level of proficiency. One of the most evident challenges to overcome about training in the AEC industry is its inefficiency in simulating real life complexity and problems. BIM arises and does its best on managing complexity. It’s almost impossible to simulate that complexity inside a training programme.

Teaching Digital Instruments is a very common practice nowadays and there are plenty of techniques and resources. At the current stage the limits of training or BIM Proficiency are all in the inefficiency to deliver practical experience without being already in a work environment, where every mistake can cost money and time to your company.

3.5. The «essence of training»: freedom to fail

In his sci-fi novel “Ender's Game”, Orson Scott Card states: «The essence of training is to allow error without consequence».

One of the main challenges in teaching BIM workflows is indeed in finding the correct activities without recurring to field learning on an actual project, where mistakes might have too high of a cost.

In a game, you don’t inherently fail but you are «free to do things that would look like failure in other contexts»⁵. This is a freedom in its own way, such as the freedom to build a sandcastle even knowing that it will crumble down once it dries out, but is also strongly connected to the freedom of experimenting and, together, they create a powerful recipe for learning. Freedom to fail in fact empowers the player with enough «room to maneuver and invent new approaches» both to known and new problems.

Also, the power of failure serves as a cognitive mechanism to teach new methods.

As Jean Piaget observed while developing his constructivism theory, knowledge is «constructed into coherent, robust frameworks called “knowledge structures”»⁶ and these structures can be shaken just through direct experience. Piaget was carrying out his studies based on children's learning and he made a very simple yet powerful observation. When presented with a short wide glass full of water, children would automatically assume it contained little water. The reverse went for a tall thin glass: as the glass was tall, they would assume it contained a lot of water. When presented with the fact that the same amount of water could be poured from the short wide glass into the tall thin glass, their unshakeable conclusion was that the water somehow changed in amount. There was no way of convincing them that there actually was the same amount of water in both glasses, as they had a clear perception that “taller means more” and they would not believe the teacher.

It’s a phenomenon lots of us have experienced when it comes to BIM.

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⁵ Moving Learning Games Forward (ref. cit.)
Jean Piaget’s experiment about a child’s knowledge structures: tall means more, until direct experience disrupts that concept. Showing and telling is not enough: experience needs to happen first-hand.

Autonomous self-directed failure is one of the most powerful ways we have to get rid of personal preconceptions and biases. If Piaget’s theory is applicable also to adults, it’s also one of the few ways we have to question the “knowledge structures” that prevent us from learning concepts in new frameworks.

Freedom to fail unlocks powerful mechanisms too. If a learner feels free to fail, he also automatically feels free to take risks and might try and do things differently than he normally would. This might result in failure, in the learner’s head, but might also be designed by the teacher as simply an alternative way to success”.

One of the main environments where freedom to fail is embraced and encouraged is games.

This is why, when developing a training path about BIM as a process, we had to resort to asking a game designer for help.

The following is his point of view on the subject.

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4. A Game Designer's Perspective

4.1. Gathering our tools: what is a game?

Despite our question being deceptively simple, over the course of the past century, first anthropology and broadly social sciences, struggled to find a single solution. Academics, right? Well, no. Academic voyeurism has little to do with this problem. By the end of this introduction our social beliefs might end vigorously shaken.

What solutions were found in the past? It is possible to collect some common, basic element shared by all gaming activities across the human experience?

**Johan Huizinga**, in *Homo Ludens* (1938), proposed games as...

> “a free activity standing quite consciously outside ‘ordinary’ life as being ‘not serious’, but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means.”

There are clearly some 19th century influences in this definition (a game is not a serious matter) but it was the first important call to arms: games are part of our life and we must understand them with the dignity we reserve to all other matters of life.
In the cold war era we had further attempts to understand this topic. Psychology took its position and sciences broadly warned us about the need to understand properly human behaviour - including for military purposes.

**Roger Caillous** in his 1961’s *Man, Play and Games*, introduced the importance of a make-believe aspect, the willingness of the act itself, along with the necessity of uncertainty in the proposed outcome.

**Sutton-Smith**, in 1971’s *Study of Games* and full-fledged american cold war style, stressed the importance of conflict, of opposing forces that will act to change the game’s status quo.

The trend is challenged by **Bernard Suits’** 1978’s *The Grasshopper: Games, Life and Utopia*. There the author proposed a system which is governed by rules, but whose rules for the most part are in place to guide the player through the use of less efficient means, in contrast with the mundane search and thought process.

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In 2003, **Salen and Zimmermann’s** *Rules of Play* simplified all that as...

“a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.”

Which worked just fine until science demanded **Jesper Juul**, in his 2005’s *Half Real*, to introduce an emotional attachment in our equation. After all, if a game is as extenuating as it seems by a not-so-quick analysis, there must be some sort of reason for people to play it instead of, say, binge-watching cake reality shows all day long. And since effort demanding games look like the third preferred human activity - sex and killing stuff being the undisputed rulers - he must have been basically right.

For the sake of brevity we ride everyone’s Number 1 designer definition, **Sid Meier**’s “a series of interesting choices”, and charge ahead to the problem at hand. To work on a game, we need tools (thoughts) about what a game is. Which bring us to...
“a limited System, defined by Rules and influenced by one or more willing Players.”

It is a very simplified version of all that come before, but nevertheless useful in reminding us that a game is...

- limited in time, thus has a known start, duration and end;
- defined by some clear, well-known and accepted rules;
- bounded by said rules to a limited, permeable space;
- influenced, directly or indirectly, by Player interaction.

<table>
<thead>
<tr>
<th>Limited in Time</th>
<th>Defined by Clear Rules</th>
<th>Bounded to a Limited Space</th>
<th>Influenced by Player interaction</th>
</tr>
</thead>
</table>

But why this one particular, clean cut definition among many others? Flexibility. By this definition, almost any possible human activity is, or can be, a game. Just identify the rules and your activity can be defined as such. Washing your teeth? A game. Breakfast? A game. Plane trip across the ocean? A game. Wage a little war? Not a game, despite what centuries of military thought struggled to achieve. Fancy yourself a nuclear superpower? A very simple game: it reads “DO NOT PLAY”.

From now on please remember: our Rule 0 states that a game must be...

- negotiable in his outcome by all players.

This can hardly be stressed enough. Negotiable outcomes mean that players are free to refuse a system’s outcome, any outcome, down to refusing to play at said game. Death is socially non-negotiable and neither are health, wealth and personal well-being, at least in the contemporary civilized world. So a game can't be defined as such if the possible outcome is either death, sickness or any form of personal damage. Good morning, Vegas!
...a game can't be defined as such if the possible outcome is either death, sickness or any form of personal damage. Good morning, Vegas!

This can be expanded further by identifying the key components of a game, an expansion of the previous analysis. For the sake of brevity, and skipping entirely the possibility of self-playing games, a branch of study that we have no need to explore for the problem at hand, a game is made of...

- **One or more Agents**
  - Humans, or “Players”
  - Algorithms, or “AI”
- **Objectives**
  - Primary, generally single and explicit, serving as the game “win” condition
  - Facultative, any number of secondary, explicit elements, adding purpose
  - Implicit, any number of obvious, if hidden, objectives and sub-tasks
  - Self-determined, established by the Players to add meaning
- **Rules**
  - Clear, unique, simple. Verbs are a good go-to rules
Empowerment

- Defining the time and spatial boundaries of the game
- Defining the Agent’s actions
- Providing sintesis to an otherwise complex system

- **Challenge**
  - Act as fuel for the system
  - Add meaning to the endeavour
  - Against self, others or algorithms

- **Interaction**
  - **Direct**, Agent on Agent
  - **Indirect**, Agent on System on Agent
  - Provide flexibility and expression

With these definitions we can approach most human activity asking ourselves some basic questions, like who is doing it, what he must do and how can he accomplish such thing.

4.2. …which bring us to the gamification of processes.

The idea of gamification is fairly new, being explored as an academic topic in the 20th century, with an acceleration on publishing from the ‘80s onward. Proper gamification as we intend it appeared from 2002 / 2003 onward and had seen significant application with the diffusion of interactive, online content. Product usability, the necessity of data manipulation and increased fidelization had stressed the development of this “new” field.

The trick of gamification, however, is that its basic adaptations can be identified as early as the 19th century, and by some extension had always accompanied human endeavour. As we understood in the last pages, it revolves mainly around three steps:

- Rationalization of the process;
- Identification of its key components;
- Empowerment of said components.
The first two parts should be common to any well-thought process - except they usually aren’t - with the latter bringing a bit of psychological spice to our dish. Key to the empowerment is player behaviour manipulation: driving his engagement and conditioning it with a series of reinforcements. This is an ethical gray line that can usually be drawn with a clear question - does the player fully understand and accept the stakes? Remember our Rule 0 before going forward.

Rule 0:
A game must be negotiable in his outcome by all players.

Usually, in the contemporary day gamification of a process, the answer is “no”. The system uses empowerment to create attachment in the player, an attachment that differs from what he expected, building a false sense of belonging or achievement.

In our endeavour to use game tools to empower our user we must remember that the simplest of uses is usually the most effective. One of the most ancient uses of gamification is S&H green stamps - a form in which the user accrue stamps to be redeemed at stores for discounts or prizes. An even simpler form can be found in the sales of breakfast cereals: the user buys cereals for breakfast and eats them. The seller empowers this action by providing small rewards or discounts for continuous use. All of this create a sense of attachment and belonging without changing the actions performed.
This example, while quite common, is clear and simple enough to understanding the elements we’re working with:

- The player’s actions (mechanics) did not change;
- The player’s goal (objective) did not change;
- The player is rewarded in a small, significant, beneficial way: less expenses, small toys for the child at heart;
- The player is restrained from changing habits by negative punishment - the absence of said rewards and his perceived investment in time deter change.

Since we’re using operant conditioning\(^8\), we’ll take a break to further expand the concept of rewards. There are four kinds of rewards, obtained by a combination of how you apply the two basic actions - reinforcement and punishment…

- Reinforcements increase the possibility of the desired action to be repeated in the future;
- Punishments decrease the possibility of the undesired action to be repeated in the future.

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\(^8\) In the words of its inventor, B. F. Skinner, operant conditioning (also called “instrumental conditioning”) is a learning process through which the strength of a behavior is modified by reward or punishment.
And the application thereof being positive or negative in nature...

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
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<tbody>
<tr>
<td>Reinforcement</td>
<td>The user doesn’t get nasty things by performing our desired action</td>
</tr>
<tr>
<td>The user does get nice things by</td>
<td>The user doesn’t get nasty things by performing our desired action</td>
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<td>performing the desired action</td>
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<table>
<thead>
<tr>
<th>Punishment</th>
<th>The user does not get nice things if he changes something</th>
</tr>
</thead>
<tbody>
<tr>
<td>The user gets nasty things by</td>
<td></td>
</tr>
<tr>
<td>performing an undesired action</td>
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As a rule of thumb, it is best to use a blend of all four. In practice, western societies are often tailored to use positive punishment because it’s the easiest, strongest and longest lasting of the four. This takes root in cultural anthropology theory, existing in shame and guilt societies. Shame societies are based on the sense of honour and duty and enforce control through Negative Reinforcement: the citizen does not get punished as long as he perform his duties. By contrast guilt societies enforce control and self-restraint by actively pursuing the punishment of certain actions.

Since we often use the mantra “if it’s simple and it works, use it”, we must insist on why positive punishment is undesired in our scenario. Positive punishment does not teach the user anything except to avoid that specific punished behaviour. It does not teach anything new nor teaches the reasons for said punishment. The behaviour will resurface at any time the punishment is believed to be avoidable. Since the goal of high level teaching is to open up the user’s mind to experiment and adapt, the reason should be self-explanatory. Except that using positive punishment is a very strong human habit and we must completely understand this problem at the core to continue in our task. Please, do. Take a minute, let it sink in. Then go grab a biscuit and reward yourself for a job well done.

Those tools, and the warnings that come with them, will help us in our next section, in which we describe the process that leads to the creation of a learning frame for BIM users.

4.3. Gamification, or: do not fix what’s not broken

While I was studying this, three thoughts passed my mind in rapid succession:

- *Gamification is unethical*,
- *Gamification is a fraud*,
- *Gamification is awesome*.

In hindsight, they are truer and truer.

The unethical part first: with operant conditioning we’re changing our user behaviour without his consent, usually without him even noticing it. This form of predatory habits in the product owner
and dependencies in the user akin to those present in gambling realities, was a problem that rose to such importance that every modern state felt compelled to regulate it with severity.

As a professional appointed to gamify something (anything, really), you are changing users’ behaviours without them knowing what you are going to achieve and you must make sure that your client is aware of all implications. Here the simplicity of the implementation hides the complexity of the preparation. This is by definition a design problem. You need to improve a system not by adding features but by removing unnecessary ones. You are given a complex system and must find a simple synthesis for someone to use, whom you’re never going to meet.

The incredible part is that a student, any student, is playing a game called “learning”. We do it without knowing, or to be more precise, we do so in conventional teaching. To play is to learn, and we can improve our methods by working with our natural attitudes.

4.3.1. The BIM challenge (“La sfida del BIM”): A case study
If you do not know what a gamebook is, stop and search google for Lone Wolf: it’s free thanks to its author’s wisdom and you can hate me later for all the blood and impotent rage you’re going to waste. Besides, you’re now 35 pages in and seriously need a break.

Done? Back to this paper and in our sample experience, we can start by laying out our needs and goals:

- Chiara was asked by our editor to write an introductory BIM book for small Firms entrepreneurs and
- she considered traditional teaching to be ineffective when approaching said subject.

About this you already had an explanation in the initial parts of this handout.

This is where she asked me for counsel and we started working on an hybrid between her methods and game design techniques. This was largely possible due to a shared experience in the construction industry and the ancestral parenthood of all Design branches.

Our first approach was to devise a gamebook on BIM, which might also work for Revit or whatever you need to teach. Either the previous pages have gone to waste, or you expect me to expand on that. We must understand…

- who our user is;
- how he expects to learn the subject at hand;
- why he thinks that will be useful;
- what can we afford to do.

Which in our case could be summed up as…

“our user is a Firm owner that will need to keep up with the times and study BIM implementation for the foreseen future if he doesn’t want his practice to become obsolete and rapidly sink into oblivion.”
Ah, Fear, the most powerful and ancient of humans’ motivators. You’re going to love it, because it’s never going to leave you. Especially at night, while you sleepless think about your bank accounts. So, let me rephrase that for you…

“our user is a small-time Firm owner or consultant that wants to understand what this BIM fuss is all about so that he can work with his inner circle in a first time implementation of a BIM process dodging the impending avalanche that’ll wipe all his CAD clean and strip his projects of credibility.”

Hopefully he’ll start on a small project, one that looks nice. And not too expensive⁹.

To recap, we must work…

- for some bored middle-aged architect;
- who knows nothing of BIM aside from it is “that thing”;
- who expects to learn BIM in an handful of hours:
  - and then push the problem away on someone else’s shoulders;
  - in a bowtie-serious, you-know-who, I’ve-studied-hard approach;
- because he’s going to need it for either/or:
  - his daughter’s student loan;
  - his own new all-terrain-but-Milan-mostly car loan;
  - the daily dose of shoes.
- and must be done with a product that’s perceived as traditional, serious and worthwhile

Luckily for us the editor was not too fond of this “serious approach” either.

The next step was subsequently easy: discard the gamebook idea. Go to the drawing board and throw MAD SCIENCE at the wall until something sticks. Gamify the heck out of it! Enter badges, a specialized app, plan events that empower diffusion of knowledge and help-your-neighbour contests!

Then talk a bit to the editor, have a cold shower and throw it all away. You know what? That gamebook idea was pretty neat. We should do it. All we need to do is throw it away and write a normal book that’ll answer to our user expectations. So this is what we’re going to do: write a book on BIM that…

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⁹ To further expand on this specific topic, called “Choosing the Pilot Project” during an implementation, you can dig up a previous class from Autodesk University 2017. [http://au.autodesk.com/au-online/classes-on-demand/class-catalog/2016/revit-architecture/ar20686](http://au.autodesk.com/au-online/classes-on-demand/class-catalog/2016/revit-architecture/ar20686)
• has a part explaining standards and the state of the art for BIM in your Country, or Lecture;
• has a part showing what can be done. or Demo.

and then...

• has a part that reinforces what’s been taught and make sure that your user is happy
to study and does his homework too, or Action

Take a moment to let this sink in. If you’re a teacher, laugh maniacally with a deep, villainesque

tone.

We chose to stick to a teaching method we knew well and had faith in: the L-D-A system. All we
had to do was spice things up giving the user the right mindset and right place to practice.
One that could be entered and exited at the user's leisure and without consequences for failure
or experimentation. In other words, a game.

With these thoughts in mind, we went to the trashcan and retrieve that gamebook idea: it might
turn out to be useful for the third part of our product after all. It should be obvious and by now
must sound like a mantra:

• we did not change the learning patterns of the user;
• we did not change the learning tools the user is accustomed for;
• we did help the user understand his objectives and needs;
• we did introduce a small reward system.

The latter being the subject of study for the last part of this chapter.

Before that, let us be even more explicit:

We added a positive reinforcement to the normal user behaviour (studying) by adding a desired
reward (a game). Since studying is serious business and gaming is not serious business (you
wish...) the user perceives the gaming part as a reward, no convincing needed! Games are fun.
So after being a good boy our user feels it’s his right to have a bit of fun. Younger kids might
feel compelled to skip the boring part and jump right into gaming. That’s a well devised trap in
itself and it will work based on a little trick called Tangential Learning. More on that later.

First things first. Our user did his studying, then joined in the game, stole a few biscuits from his
secretary and learned the rules of the gamebook. In case you are a boring person and hadn’t
googled it when I first suggested it, here’s how a gamebook works:

1. you start reading a line, labeled “1”. At the end of said line you are required to go read
   the line labeled “2”,
2. eat a biscuit, it’s jummy! As we approach the end of line 2, you are required to jump to
   line 4,
3. Sir, this is line 3: here you are called a cheater and a liar and asked to jump to line 4 for real,
4. at line 4 you are told you're a good boy and can either bravely walk on to line 5 or search another route and sneak your way into line 42,
5. at line 5 you die. Just being honest here.

This framework uses all the important bits of game building. Mechanics are simple and clear, player choices are impactful, reward is proportionate to his effort. Just try to be gentler with your player's first opening moves in line 5.

Being a framework for implementation, this gamebook develops a narrative, which in turn develops belonging, attachment and meaningfulness. Our user will, each time he plays along, develop his own story based on his own choices.

Here we encountered a new roadblock.

First, storytelling has little to do with game design. It's like being your own cousin. I'm from a mechanic-oriented game design school, so I'm my own uncle at best but more probably someone else's father.

Secondly, the main experience our user ever had with storytelling is linear: you start at chapter one, skipping introduction and prefaces as everybody does, skim through all paragraphs and reach the happy ending where everyone lives happily ever after. We determined not to use that because, well, there are no choices in linear paths apart from, possibly, laying down and immobilized at the roadside, slowly dying of boredom. Non-linear storytelling on the other hand is usually encountered in four types:

- **Emergent**: the user actions build the game world. Good luck using that in a finite book. This is primarily used by game manuals and roleplaying games. It's a hellish place littered with dead projects and broken dreams. Remember, by definition a game is limited in both space and time.

- **Labyrinth, Standard**: here the user actions branch out more and more as time passes, building up very different scenarios. It contains the most interesting choices but it's a bit impractical in a small gamebook setting, due to page constraints. It's still affordable in small doses or as a hybrid for other templates.

- **Labyrinth, Linear**: this is a fake labyrinth and the most common in ancient times. It develops a structure and guides the user through a determined experience while maintaining the illusion of choice. Good for mystical experiences, bull chasing and catharsis.

- **String of Pearls**: the player choices branch the narrative out but each “chapter” brings the player back to a certain common checkpoint. Most videogames follow this route, retaining a certain amount of personalization while at the same time remaining in the realm of affordable development expenses.
After a bit of experimentation we managed to avoid Emergent and chose to stick to String of Pearls.

We proceeded to develop a light legacy system for our player to take note of his actions and progresses between checkpoints, then proceeded to develop a series of guidelines. In case you’re wondering, here is the place where I emphasize the importance of planning. Not a single line of our book had been written at that time. Not a damnable line of content either. We’re not done yet as we need to know…

- what good practices we want our user to learn;
- what resources best represent the complexity of a Firm;
- how frequent and drastic must the user failures impact on progression;
- what should be our user end goal within the narrative frame;
- how to expose secondary goals and award player’s experimentation.

5. Define your Goals as a Teacher

As Gabriele said, before we could think about defining the rules of our game we needed to define our goals as teachers. Each rule you put in the game has to convey a strong message.

5.1. Importance of Choice

As we said before, the first message we are conveying when picking a choose-your-own-adventure scheme (a gamebook) is the importance of choice. You are presenting the student with a ramified pathway that leads from the old ways of working to the new practice but instead of giving him a linear exercise, each paragraph is a choice in itself that’ll help the player tailor his own experience.

The depiction of a scenario, and the use of narration to exploit consequences of both good and bad choices, is a powerful tool to convey two main principles:

- there's always more than one successful way to achieve a goal, so flexibility is a virtue;
- choices need to be made at the right time and with a correct resource planning.
5.2. Define Learner’s Goals
Since learning is seen as a pathway, you need to define what is the main goal. The learner needs to be presented clearly with such goal: he might be requested to finish the modelling strategy for a complex element in Revit, or to finish his first project in BIM.

This relates to one of the key concepts of adult learning: the measurability of the results. Adults won’t just settle with “you did good”:

- they need to see the destination while they are striving to reach it and ideally to know how much more it will take to get there;
- they need clear proof that they achieved it and a practical evaluation of how they relate to benchmarks of both average and excellent;
- they need rewards (but more on that later).

In our gamebook, the goal was to reach the end of your first project in BIM without reverting to CAD, getting killed by your drafters or getting sued by your client. Sounds simple, doesn’t it?

5.3. Find what determines Failure
As we said, the essence of training is to allow failure in a safe and protected environment, and the effectiveness of the method we are proposing relies on the possibility for the student to experiment and fail. Therefore you’ll need to ask yourself what determines failure.

In a simple first-person shooter, failure happens when you run out of life. In a game all about stealth, failure might present itself when you are seen by others during a mission. In a chess game, failure happens when your most important piece runs out of moves and gets eaten by your opponent.

This is how our string of pearls looked like at the end: we used Twine, «an open-source tool for telling interactive, nonlinear stories». Perfect.
What is failure when you are using Revit? And what is failure when you are working in BIM? The answer will determine the cornerstone of your teaching framework.

A pathway for Project Managers might revolve all around time, as it happens in *The Dream Team Nightmare*¹⁰: what you are basically saying is that time is of the essence and the right choice at the wrong time is a wrong choice.

A pathway for Value Engineers might revolve all around building performances: will the hero be able to cut costs without having the building crumble down to pieces? What you are saying is that cutting costs is the goal but keeping quality high is the real challenge.

A Revit modeller might have to confront himself with model performances: will the hero be able to model that facade without overdoing it in such a way that will render his work unusable for others?

The tricky part is that there isn’t a right answer: it’s a matter of choosing one value amongst all others and making it the most important one. If you pick something material, as money, you will be saying that it’s all that matters. Our suggestion is to pick a positive value, such as the quality of your building, the happiness of your team, the reputation of your practice. You’ll have other means to give material values the right importance.

5.4. Fuel

What keeps your hero going? Energy is not to be mixed with life as running out of energy doesn’t automatically mean a failure but simply means your player will have to stop for a while or measure his actions a little more. If you are working in a Firm you are not technically “dead” if you’re too tired to perform a job and take a day off: you are when you get fired because of it.

As we were saying, money is a bad concept to be used as key value but it’s a very good one as is energy. Time is also a good energy value, unless it’s your cornerstone.

This is basically what your player will spend in order to progress in his learning pathway. It’s a valued thing but it’s to be seen as a means to the end, and not as an end in itself.

5.5. Tools and Instruments

To make everything a little more interesting, the learner might have some tools to rely upon during his path. It’s up to you whether having them is prejudicial or not in order to reach the goal

and this is another very important choice to be made: if you’re making tools optional, you are stating that, for instance, it’s not important to have a powerful computer to model efficiently. It’s a choice. But a very debatable one, if you ask us.

Also, if you introduce the help of other people as a weapon you have to be careful not to objectify them.

### 5.6. Rewards and Punishments

As we said, the concept of choice is crucial. The player must feel in control and bad choices are to be clearly identified as bad, with some sort of punishment. The same goes for good choices: they must generate a good mood and be rewarded. On the topic of rewards and reinforcement we have already explored this extensively. Another choice we made down this road on our gamebook was to avoid abrupt death for a player. But more on that later.
6. Designing the Gamebook

Several cases of beer later, we came up with even more scribbles that sounded pretty much like...

- the player must learn cooperation, respect and the importance of the human resources;
- the material resources can be slimmed down to Biscuits, everyone’s favourite currency, and Reputation. Biscuits are used to pay for pretty much anything and Reputation to call in favours, more side jobs, more Biscuits and the occasional conference.
- you die only at checkpoints, four in total, and even then never from lack of Biscuits. You should only die from being an inveterate jerk, constantly trashing other people’s and your own Reputation to the ground. Death must be a foreseeable event for the player.
- our user must bring home one prestigious, fictional project of national relevance. Neat.
- our user must feel free to dabble with his fallacies and expand on the possible outcomes of his small-time tendencies. Old school Achievements will suggest to the player that it is indeed possible to dabble in the wrong, obscure attitudes of human nature and, at least partially, get along with them.

This is where you can start assembling your material and start hoarding data to possibly, one day, with luck, start writing stuff in the book’s first draft. By now your project will look like a cloud’s worth of excel tables, guideline documents, references and possibly a Massive Analogic Movie Wall to connect all pieces with strings, pins and post-its. We tried to brainstorm a better way but we ran out of beers. The good news: it survived as the silliest, funniest, most convincing solution for quick glances at the String of Pearls.
Like villains of a b-movie, this was the very first instrument of planning: a Massive Wall of post-its, pins and coloured strings

Alongside the MAMW (Massive Analogic Movie Wall), these were our main instruments of work: balanced excel sheets to figure out if and where our player was going to horribly die for lack of Reputation.
You bet this was finished, but remember the trap? No? We laid down a trap for the more young, fickle minds. To be brief, it works something like this…

42. At this line you discover the effects of Nudging and learn what Tangential Learning is.

We’ll start with Nudging. Some pages earlier, we “nudged” a certain kind of user to search the line above. So, in essence, this is how you direct your user’s actions. It is accomplished by working toe-to-toe with his own biological or cultural attitudes. The simplest form of nudging will sound like this…

| Problem: male users do not pee inside the appropriate space in the restroom. |
| Solution: peeing is about directing a liquid jet onto a surface. Since the human brain is naturally wired to hit things with projectiles and the male brain even more so, we provide a target, like a dot or a painted fly. This will draw the user attention and enforce the need to hit that target. |

You wish this was a fake example but it isn’t\(^{11}\).

It never gets simpler than this. Like most things that work quite well, it sounds a bit silly once you realize that… you are directing your user to do what you want by having him doing what he’s used to do in the first place.

We “nudge” things every day of our life, or at least we do it when things work out by themselves. It is not foolproof, nothing is, but is simple and effective. The long, hard part is the usual preliminary study of your users.

On the other hand, we have Tangential Learning, possibly the primary motivator of human progression. We play baseball, we learn to throw balls. Or maybe we learn how to work in a team, we learn how strong our muscles are, and the pleasure of taking a day off to roast stuff of dubious nature with our meaningful ones. Tangential Learning is all the things you pick up by doing something else that is not explicitly required by an external goal. Its power comes from being born from secondary, self-determined objectives, whose completion in turn releases dopamine: you effectively stone yourself with knowledge, a fact experienced by anyone that had wasted a night browsing wikipedia and suddenly found himself knowing all there is to know on scaled mammals. By devising a gamebook we provided a simple frame for our user in which he can experience the book’s content… without reading it in the first place.

To achieve a clear, known, old school goal our user might be tempted to stick to old habits. Our gamebook shows the consequences of it. He might also be curious about trying new solutions, like an hybrid between sketching techniques and 3d modelling. He does not require a particular set of skills to do so, but is exposed to consequences and is brought to adopt the right mindset

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\(^{11}\) See for example Aiming To Reduce Cleaning Costs by Blake Evans-Pritchard in Works That Work, No.1, Winter 2013. [https://worksthatwork.com/1/urinal-fly](https://worksthatwork.com/1/urinal-fly)
necessary to search for the right tools. As exposed in Chapter 4 this is an essential part of adult learning and well within the boundaries of L.D.A. framework.

6. Conclusions: Game Design is a Serious Business.

Training the AEC manpower in learning Building Information Modelling processes and tools is one of main activities to tackle in order to reach a greater diffusion and a full maturity phase for BIM. Is it also a huge business considering that it involves not only the young generation still studying in the universities but also the majority of professionals working across the industry.

The traditional techniques, based on the Lecture-Demo-Activity framework shows a lack of efficiency in the activity phase, especially when the goal is to teach the process. A game can be an efficient tool to fill this gap in order to broaden the effectiveness of training. Regardless of appearances, designing a game is a serious business, and the mismanagement of the rules can produce very negative effects on the training programme. Moreover, in order to create a game for education, it’s important to define and support a set of moral values.

6.1 Gamification is an even More Serious Buisness

Gamification begins when you start applying game dynamics to ordinary life tasks. It’s a very powerful tool and widely used in modern society. It can be used for positive scopes, like to improve training or to direct towards a set of moral values. On the other hand, it can also be used in a negative way to enforce behaviours or moral values without informing the users. There are several moments in History where it’s possible to spot gamification techniques applied in a controlling or predatory way.

From a philosophical point of view, Games and Gamification are instruments and not tools: while a tool is something like a hammer, and plays a crucial role in helping us do better something we already did before its invention, an instrument is something that goes beyond. Every instrument empowers human ability and skills set, but it’s the man who decides how to use it. An instrument isn’t good or bad: it’s how do you use it that makes the difference. Even in the most technical job you can’t avoid considering the moral consequences of your actions.
7. Appendix: Play a Game

As an example, here’s an exclusive game: you booked a class at 8 am on Thursday. Will you be able to surf through Autodesk Block Party (or not) the evening before, and fulfill your destiny?

<table>
<thead>
<tr>
<th>Character</th>
<th>Activity Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soul of the Party</td>
<td>Have a beer with at least five different experts.</td>
</tr>
<tr>
<td>Knowledge Seeker</td>
<td>Gather secret knowledge without having a single drink.</td>
</tr>
<tr>
<td>Meat and Three Vegs</td>
<td>Gather your notes, have a beer with at least three people then attend the class.</td>
</tr>
<tr>
<td>I know that guy</td>
<td>Have a beer with all three speakers, then attend their class in the morning.</td>
</tr>
<tr>
<td>Go West</td>
<td>Ride into the horizon with a true futurist.</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Dried out</td>
<td>Gather your notes then drink yourself into oblivion.</td>
</tr>
<tr>
<td>Stripped</td>
<td>Leave the conference and have fun in Vegas.</td>
</tr>
</tbody>
</table>

Choose your goal

Amongst these objectives, pick the one that suits you the most. Your goal while surfing through the game will be known to you and only you.
Ready? Go!

Autodesk University is like riding a bike on a rope between two whales, while sailing the ocean in the middle of the storm. Always... interesting.

It's Wednesday and it's 7 pm. You just went back to your room after a full day of classes and the AUGI Annual Meeting. You have a whole load of notes, handouts, slides, pictures and business cards to sort out, but the Block Party is about to start.

Priorities, priorities, those priorities will kill you.

What do you do?

- Stay in your room for a while: [[34]]
- Go straight to the party: [[7]]

Stay there and drink the future

You stay there and have few drinks. At a certain point, you even manage to climb on the horse and help the guy delivering drinks. It's almost morning. You have a terrible headache and you must have said it out loud, because the guy in the blue suit answers: "Don't you tell me, dude: I've got the keynote in three hours".

- Give him your aspirin, because he'll need it more than you do: [[35]]
- Leave him be and go to bed: [[10]]

Keep walking

Those boots were made for walking, so you walk and walk and walk. It's late when you reach the party and everybody seems to be having a lot of fun. Mechanical designers and architects are mingling with digital designers and those weird Dynamo guys. You walk through an open-air casino and see a group of guys with beers at the end of the road: they have a familiar face and are shouting a lot. You hear the words 'IFC' and 'COBie'.

- Stop at the bar: [[14]]
- Reach the UK guys: [[19]]

The other guy
The guy is talking with an American who's going around with a selfie stick, taking pictures. In particular, they are talking about nodes and lacing: after an embarrassing moment you realise they are referring to Dynamo. They ask you if you use rhythm, whatever that means, and offer you a beer.

- **Enough drinks for one night, go back to your room:** [[26]]
- **There's a guy curled up in a corner: see if he's alright** [[15]]
- **Run for your life (and go somewhere else):** [[5]]

---

**Keep Following the noise**

At the very center of all the glitter and noises, a huge solar-powered metal horse stands in all his might. At the saddle there is this guy in a light-blue suite and he looks a lot like Autodesk's new CEO. People are climbing on the horse to reach him and he's 3d-printing mojitos to his adoring crowd, while presenting the invention as 'the future of making drinks'.

- **Stay there and drink the future:** [[2]]
- **Enough drinks for one night:** [[26]]

---

**Too late to bother: stay in bed**

You decide to stay in bed. Your headache is too big, you are way too tired and you feel like a monkey is screaming in your ears. Too bad for those Italian guys: you'll see their class on-line.

- **Reach** [[30]]

---

**Go straight to the party**

Shimmering! Shiny! The party is all you expect a party in Vegas to be. It has dancers, singers, people laughing and drinking, and a guy who's trying to juggle a couple of ReCap models without dropping them.

You don't know where to turn your head.

Right in front of you, a group of three very noisy people are chatting in a strange language. On the other side, a casino is inviting you in.

- **Reach the Italians:** [[16]]
- **Enter the Casino:** [[18]]
Class is only two hours away: keep drinking till the morning comes

It seemed like a nice idea, but maybe you were too tired. You must have fallen asleep on the counter, because somebody moved you towards a corner and placed you on a bench. They stole your cellphone, your Autodesk University pass, the picture of your dog from your wallet. You have a massive hangover. At least they didn't take your aspirin. You ask for a glass of water, swallow it and then stumble towards your room. All you need is a shower and sleep throughout the morning. Too bad for those Italian guys: you'll see their class on-line.

- Reach paragraph [[30]]

Fantastic!

At this point you're ready to face the challenge of BIM: its adoption as your main production method. You'll face choices, difficult ones, and you'll have to make tough decisions in order to reach success for your Firm and for yourself.

Each choice will have consequences: they can be positive or negative, they might affect your reputation, your technological infrastructure or the human resources you have at hand.

- Go to [[11]]

Try to get some sleep

You have an aspirin, but your mother always told you not to take pills when you're drunk. On the other hand, you have very little chances to rise early enough to attend the first class. What was that again? Those Italian guys and their weird teaching techniques...

In the morning, Your alarm clock keeps ringing and ringing and ringing. When you manage to face it, it's 8 am. Your first class has already started and you have a massive hangover. You even ran out of aspirin. What do you do?

Try and reach class anyway: you'll be late and everyone will stare at you.

- Go to the class anyway: [[25]]
- Too late to bother, stay in bed: [[6]]

O'Reilly?
Did it really look fantastic? You're jumping randomly around, but that paragraph wasn't connected to anything. You're dead. Probably killed during the party because you entered a dark room that said "Do not enter".

- Go to [[1]] and start again.

**Fantastic!**

Achievements are collectable badges. They exist to tease you: how many weird situations you can get yourself into? How many horrible ways you have to ruin your lifetime work and your reputation as a respectable professional? How many ways to success?

- Go to [[11]]

**You decide to get dressed and go down**

While you reach the lobby, the usual expanse of slot machines and gambling tables shimmers under the spotlights and a girl approaches you with a cocktail.

While you're there, deciding if you really want to go to the party or if you'd rather stay, a guy crosses you, quite in a hurry. He's holding two beers with one hand, wears a sleeveless black-and-white fur and is covered in tattoos. You know the guy: he's awesome!

- Follow Jay and have a beer with him: [[39]]
- Oh well, it's Vegas after all: stay and place a bet. [[18]]

**Stop at the bar**

The casino has a nice separate bar with nice girls and guys, and nice drinks, and nice screens with a nice replay of a football match. All of a sudden the party seems too noisy, too full of people, too far away to bother. You order a drink. And then another. And then another. And then another. All of a sudden it's 4 o'clock in the morning.

- Keep drinking till the morning comes: [[8]]
- Try and get some sleep: [[10]]
That guy with the headache

There's this one guy, standing in a corner and keeping an eye on the defensible space around him. He is complaining about a fierce headache and that there are too many people around. You tend to agree.

- Give him your aspirin: [23]
- You've had enough and it's time to go back to your room: [26]

Reach the Italians

You realize they must be those weird Italians: you subscribed to their class. You might decide to stay and harass them: they look like it could please them.

- Stop and have a beer with them: [28]
- Enough drinks for one night: to back to your room. [26]

Follow the girl

She meets with a guy who seems to be the leader of a vintage rock band. By googling him, you realize he is. They chat a bit and you are able to intrude: the girl asks you if you can find her associate and pass him a note.

- Accept and look for the other guy: [4]
- You don't feel like being an errand boy: go back to your room: [26]

Oh well, it's Vegas after all: stay and place a bet

You place a bet at one of the tables, and then another, and then another. The dealer is a really nice girl and she seems to get slightly sad every time you mention you should leave, so you stay. At one point, you even win something and the girl with the drink from the bar keeps circling around you.

- Stop at the bar: [14]
- Stay there and keep gambling: [33]
- Go to sleep: [40]
Reach the UK guys

There they are! The #ukBIMcrew guys are sitting on a throne of empty beers and have improvised a BIM open mic. A blonde girl is now talking about COBie in a rather passionate manner and you manage to say hello to one of the guys. They offer you a beer and ask you if you want to participate.

- Keep exploring: [[31]]
- Accept and cheers! [[42]]

Go down, eventually

Those guys. They can be pretty persistent.

You decide to get dressed and go down, eventually. A good chat never hurt anybody.

While you're in the elevator, you drop them a line but nobody seems to be answering, right now. While you reach the lobby, the usual expanse of slot machines and gambling tables shimmers under the spotlights and a girl approaches you with a cocktail.

- Oh well, it's Vegas after all: stay and place a bet. [[18]]
- Try and reach the party: [[36]]

It's better to rest: prepare to go to sleep

While you are brushing and flossing your teeth like the good kid you are, your cellphone starts chirping. You forgot to turn off notifications and the #ukBIMcrew guys are being rather vocal about how fun the party is. Some of them are even wondering where you are, and are looking for you.

- Go down, eventually: [[20]]
- Resist temptations and go to sleep: [[29]]

Fantastic!

Whilst the science of teaching to children is called Pedagogy, another term was coined during the 70s to refer to techniques and methods used with adults: the term is Andragogy and was rendered famous by American educator Malcolm Knowles.

- Go to [[11]]
Give him your aspirin

He eagerly takes the aspirin and curls up into his poncho, like a cocoon. When you start to think he's dead, the open his eyes and bursts out like a butterfly. You start talking and he tells you he's a game designer. He's the one behind the gaming part of that weird Italian class about alternative teaching techniques. You digress and start talking about chess. You digress and start talking about ancient Anatolian military strategies. You digress again and find yourselves planning to build your own pyramid.

Time passes.

You wake up in the morning, in a basement, sitting at a computer. A match of Civilization IV is still going on. The Italian guy left, probably to go and teach at his class. He left you a note in Klingon. But that's not the worst part. The worst part is that now you can read the stuff.

- Reach paragraph [[30]]

Fantastic!

Adults feel the need to be treated as equals by their instructor and they respond very well when they have an active part in the shaping of their learning path. Flexible programmes are preferable, with multiple choices available to reach the same goal, also because learners with the same goal might have different preferences about the means of learning (reading vs. listening is the simplest example to grasp this concept).

- Go to [[11]]

The End!

You arrived to the class, congratulations! Did you get what you wanted?

Enough drinks for one night: go back to your room

You feel like you had enough drinks, for one night. You go back to your hotel and on the way you walk again alongside all those slot machines and gambling tables. Your bed is calling you. You're starting to develop a headache. Tomorrow you have a class at 8 am: it's that class about gaming and teaching, those weird Italian guys.
Fantastic!

At this point you're ready to face the challenge of BIM: its adoption as your main production method. You'll face choices, difficult ones, and you'll have to make tough decisions in order to reach success for your Firm and for yourself.

Each choice will have consequences: they can be positive or negative, they might affect your reputation, your technological infrastructure or the human resources you have at hand.

- Go to [(11)]

Stop and have a beer with them

You manage to intrude and buy them a beer. They seem to be pleased and are happy to stop and chat, although with alcohol they get this weird Super Mario accent.

You ask about their class and they tell you what's it all about: it's about how you need challenging activities in order to teach to adults, and how designing a game can help you provide students with such activities.

It seems to be interesting.

Talking about it, on the other hand, seems to be making them anxious.

They want to split up, to cover more ground: the guys are aiming to reach some BIM open mix stuff organized by the British; the girl is looking for her mentor, she says.

- Reach the guys: [(19)]
- Follow the girl: [(17)]

Resist temptations and go to sleep

You put your pajamas on, grab your teddy bear, adjust your night cap and go to sleep. It's 9 pm. My grandmother in her 90s was more of a party animal than you are.

The next morning, your alarm clock rings at 6 am and you've had your nine hours of beauty sleep. You didn't meet anybody. You haven't even seen the sky outside the convention centre.
You rise, get dressed, have breakfast and go downstairs. You've got this class to attend, it's called "The BIM Challenge". Everybody seems to be a little tired. People are yawning, some of them are swallowing aspirin. However, they seem to be slightly happier than you are. Everybody knows each other, except from you. Autodesk University: are you sure you're doing it right?

The End!
You didn't reach the class: is this what you wanted?

Keep exploring

Ok, that's weird.

There's one guy, with dark curly hair and a contagious laugh, he's wearing a cool Star Wars t-shirt and is using his cellphone to try and animate, in augmented reality, an AT-AT mechanical walker made of empty glasses. He seems to be close to success but he needs more glasses to finish the model.

- Help him and have a beer: [[38]]
- Enough drinks for one night: go back to your room. [[26]]
- These are not the guys you're looking for. [[37]]

Fantastic!

Achievements are collectable badges. They exist to tease you: how many weird situations you can get yourself into? How many horrible ways you have to ruin your lifetime work and your reputation as a respectable professional? How many ways to success?

- Go to [[11]]

Stay there and keep gambling

Lady Luck is smiling, tonight! You stay there and keep gambling. Hours slips away and so does money from your wallet. At a certain point you realize you gambled away your shoes, empty wallet, your AUGI membership, your Autodesk University pass and that nice handout those Italian guys wrote about games and gamification techniques for teaching. You don't feel like you learned something, but it's Vegas: who
cares? You keep gambling. They will know you in every casino of the strip, they will know your name. You might call your self 'Wild BIM Hickok'. It has a nice ring to it.

- Reach paragraph [[30]].

---

**Stay in your room for a while**

You decided to stay in your room and take a moment to let all that knowledge sink in. Parties and networking might be important, but you're here for the learning.

A whole hour passes: you organize everything in neat little folders on your computer and feel like a good kid who did his homework. It's 8 o'clock.

- Ok, go to the party now: [[13]]
- It's better to rest: [[21]]

---

**Offer him your aspirin**

He politely thanks you, and puts it in the pocket of his jacket. He doesn't take pills while drunk, he says, but it will certainly save him in the morning. He 3d-prints himself a coffee and offers you a lift to your hotel on the metal horse: you happily ride towards the strip, while the sun rises.

- Reach paragraph [[30]].

---

**Try and reach the party**

You walk towards where the party is: maybe you'll simply stumble across them. After all, Autodesk University only counts around 10.000 attendees every year: how hard can that be?

You walk next to the bar, which has an inviting cocktail menu on display and a nice bartender smiling at you, and the party is far away down the strip.

- Keep walking: [[3]].
- Stop at the bar: [[14]].

---

**These are not the guys you're looking for**
You try and see if somebody else is around and while you're looking for someone to mingle with, a girl bumps into you. She has a strong Italian accent, a latex skirt and seems to be born in a hurry. She asks you if you have seen the Revit rocker around.

- Follow the girl: [17]
- Enough drinks for one night: go back to your room. [26]
- Follow the noise to another road: [41]

Help him and have a beer

You have a beer for the sake of knowledge and the experiment seems to be working! The guy tells you he'll write a blog post tomorrow and invites you to participate in his podcast. All of a sudden you realize who you're talking with, but he gets called by other guys down the road and you lose him.

- Try to get some sleep: [10]
- Follow the noise to another road: [41]

Follow Jay and have a beer with him

You manage to grab him and lure him to talk with you using a well-placed ice-cold beer. You have a long chat about collaborative frameworks and painting and music and teaching and tattoos. At the end you feel like you had your brains in a blender, but it's a nice feeling.

It's getting late.

At the end of the road you see other guys gathering and sounds of the party going on.

- Keep exploring: [31]
- Enough drinks for one night: go back to your room. [26]

Go to sleep

You put your pajamas on, take an aspirin, grab your teddy bear, adjust your night cap and go to sleep. You feel tired and a little drunk.

In the morning, your alarm clock rings at 6 am and you haven't had your eight hours of beauty sleep, but you feel like you can manage.
You rise, get dressed, have breakfast downstairs and see lots of people you met the other night. You say hello and then go to attend your class. It's called "The BIM Challenge". Everybody seems to be a little tired. People are yawning, some of them are swallowing aspirin. However, they seem to be happy.

- Reach paragraph [[25]].

---

**Follow the noise to another road**

You keep following your instinct... or is it just the noise you're following? There seems to be like an epicenter of fun and networking, somewhere, but it's like chasing the golden pot of a leprechaun: just as soon as you think you reached the end of the rainbow, you realize it shifted few miles away. You might get to Florida, at this rate.

- Keep following the noise: [[5]]
- Go to sleep: [[40]]

---

**Accept and cheers!**

Cheers! It's always fun to meet with these guys and this is what Autodesk University is all about: people, knowledge and fun! Or is it?

All of a sudden, an American bursts in, takes the mic and delivers a rant about BIM and contracts. He's holding two beers with one hand, wears a sleeveless black-and-white fur and is covered in tattoos. You know the guy: he's awesome!

- Follow Jay and have a beer with him: [[39]]
- Enough drinks for one night: go back to your room. [[26]]