Representing humans in technical illustrations

Good technical illustrations show not only the object but also the person handling it. So, how can we involve an actor without exceeding the budget and time limits? Vector-based mock-ups offer a solution.

Text by Marco Jänicke

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Instructional illustrations are a key component in supporting instructions in text form and making actions comprehensible. In such illustrations, the focus is not only on the object of the instruction – the product –but also on the acting person – either the whole person or only the hands. Instructional illustrations without an actor are passive constructions. Representing the acting persons creates an active visual instruction. In this way, specific activities are revealed quickly and become transportable beyond the possibly complex descriptions in the text.

Two bases define the term "technical illustration" in technical communication: the standardized basis and one based on conventions. The standardized basis is outlined in the design guidelines for safety signs, ISO 3864-3, and, almost in sync except for nuances, ANSI Z535.3. These standards contain distinct specifications for the representation of persons and hands. These are highly abstracted and stylized for safety signs, but the structures correspond to the human anatomy and are adaptable to provide a safe warning.

We find another basis in conventions, implied and learned rules to represent the actors. The assembly instructions of Ikea – an almost cultural heritage of our days – are

an ideal example of this. On the one hand, assembly instructions apply a comic-style human representation, yet on the other hand, this person is real enough to be recognized to convert the contained information to reality. Most of us have already assembled such a piece of Swedish system furniture. The comic style is used in the Ikea instructions as a kind of visual preface. Figures without specific features, but with facial expressions, give basic information before the actual assembly instructions. Outlines of people are applied for individual assembly steps.

So, how can we use the advantages of involving actors in instructive images in an industrial environment? Technical illustrations for industrial products have a large number of variants in plant engineering and special machine construction, yet they are subject to narrow time limits and the objects of illustration are not always available. After all, this is not about creating illustrations for glossy brochures. In this environment, it is not about the absolute best result, but about the **best possible result** with **optimal effort**. The essential measure for the best possible result is that the instructional illustrations of people and hands are understood. Optimal effort means that the time budget, and thus the costs, are not exceeded by the illustrative additions. Such efficiency is made possible through standard tools in 2D (Corel DESIGNER, Inkscape, Adobe Illustrator...) and 3D (Lattice XVL Studio, SOLIDWORKS Composer, Creo Illustrate...) and digital vector-based mock-ups of people and hands.

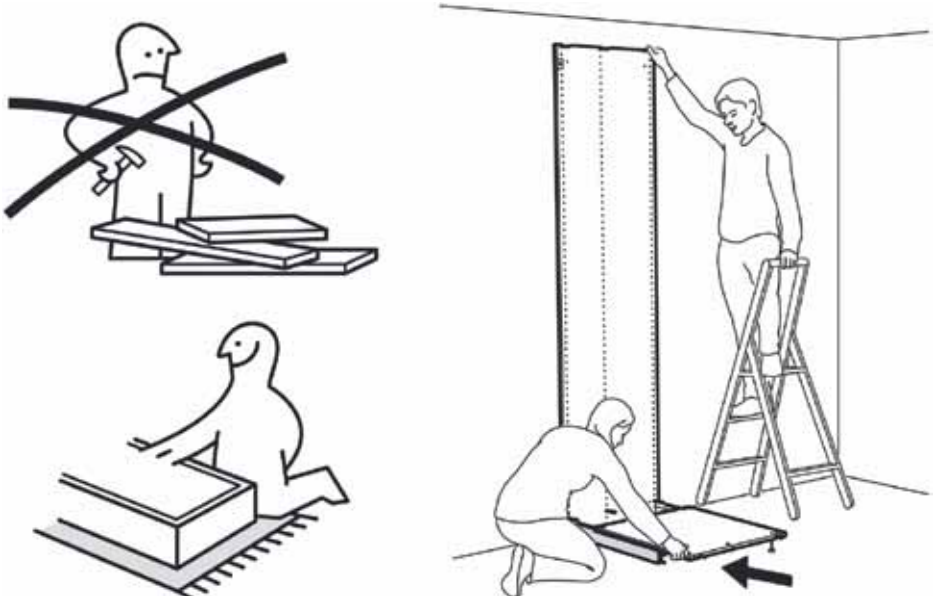

Figure 2: Representation of acting persons based on conventions
Source: Ikea

Digital mock-ups vs. photographs

Mock-ups are dummies, simulations, or models of typical products used to visualize or investigate ergonomics or design aspects of products during development. If these mock-ups are vector-based, we transfer common working methods and advantages of technical illustrations to 3D models of people.

If you don't want to or can't use vector-based digital mock-ups, but you still want to show the interaction between people and products, you will have to work with photos. However, these have many disadvantages:

- The subject of the illustration must be present.
- Access to the subject of the illustration must be possible.
- Photos have blurred perspectives with often misaligned lines.
- Photos are not ideal for combining with other photos with a different camera position.
- Photos require high effort to reduce details by cropping or tracing.
- Photos can only be reused to a limited degree.
- Variants and upcoming variants cannot be represented with one photo.

These disadvantages make it clear that digital mock-ups are the best solution to represent people in an industrial context. Before we start sharpening our digital pencils, we should be clear about the situations in which human-machine interac-

Figure 1: Representation of acting persons and hands based on standards
Source: ISO 3864-3

tion is most necessary: basically, whenever there is a concrete instructional intention. This is always the case when, for example, hand illustrations with standard tools such as hammers, screwdrivers, etc. are shown. No matter how broad the target group, the handling of such tools can be assumed to be generally known. While illustrations for standard use cases are readily available and can simply be reused, this is not the case when it comes to the use of special tools or the obligatory handling of sophisticated components. In these cases, illustrations would add much value; however, they require individual effort. This illustrates our case in point: Where instructive illustrations are necessary, these illustrations should be supplemented with information on force, direction, and dynamics.

Illustrations of hands and handles

Static illustrations of hands offer little information with regard to movement and dynamics. Arrows might offer a helpful alternative or addition to keep in mind. As opposed to hand representation, arrows typically obscure much less of the illustrated subject. They also indicate direction and movement. Combining the representation of hands and arrows, we utilize the information content of both possibilities for optimal instruction.

Hands and handles in 3D

If the illustration object is available in 3D, we must also "assemble" the hands as 3D objects into the scene in a 3D authoring tool. The illustrator is free to position and project the hands in whatever way suitable, yet this requires relatively high effort to manipulate all elements of the hand (five fingers, three limbs). For added efficiency, the vector-based hand representation can be created together with the 3D model of the machine. For the quality of the vectors, the 3D model of the hand is the essential factor.

Hands and handles in 2D

For 2D illustrations, hands are recreated as 2D vector objects based on photos. A photo is often necessary as a basis for providing details about the size of the hand representation. Unfortunately, all the disadvantages of photos listed above take effect immediately. This can only be

Figure 3: Hands and vector derivation based on 3D models

mitigated step by step by building up a library of hands and grips in the 2D vector software.

Regardless of how the hand representations are created, they must be enriched with further information. The amount of force by type of grip is an existing but uncertain piece of information. Specifying the force needed to tighten a grip might bring clarity. Remember, however, that this might require small localization tasks. The UK, for example, is now returning to the old imperial system of measurement. Arrows, ideally with semantics on a standardized basis (EN 8016-2, ISO 3864-3), are used to indicate direction and movement. Very dynamic movements can be highlighted with comic-style speed lines.

Representation of people

When we show people, we have to be careful not to unconsciously convey statements that are not necessary for the context but trigger undesirable associations in the viewer. Characteristics of ethnicity and gender, for example, are such statements. In the industrial environment, in which our images of people are set, there is no need to show such characteristics. Avoiding these details eliminates the danger of being over-interpreted. The key here is the lowest common denominator of the target group. For the representation of people, this means that all stereotypes of a person must be recognizable in an appropriate way, but no more. The comic-like figures in the Ikea assembly instructions mentioned above are a good example of this.

People in 3D

Just like hands, whole persons can also be integrated as 3D models in the 3D authoring tool with all the advantages and disadvantages mentioned above. The manipulation task is somewhat more manageable here if one assumes that the hands have taken some kind of standard grip. Whether hands or whole persons, a suitable 3D model must be available. Sources for such actors – as well as 3D models of suppliers or tools – can be found on web-based image portals. The chosen models must contain a manipulable structure; i.e., they must not be monolithic as prescribed for the STL format. In the OBJ format, which is typical for visualization, such structures can be present. In the native formats of the MCAD manufacturers and the STEP and IGES exchange formats, manipulable structures are almost always present. Furthermore, it is important to take a look at the license conditions, which must correspond to the intended use.

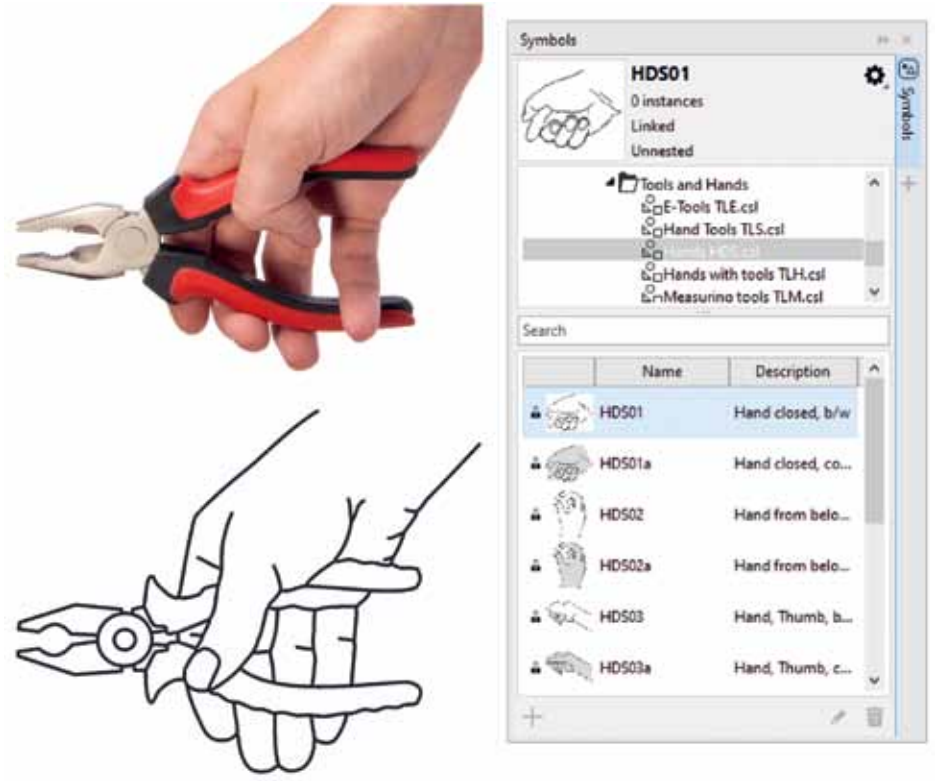

Figure 4: Design options for a photo-based hand *Photo: Colourbox.de*

Figure 5: Manipulable 3D model of a person in a 3D authoring tool

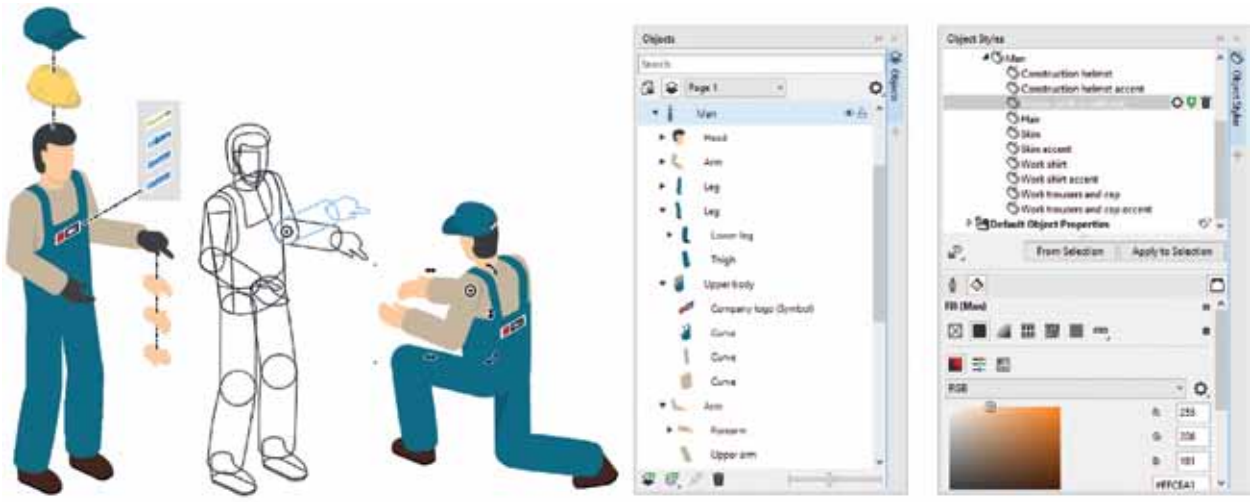

Figure 6: Person in a 2D application with structure, object styles, and referenced objects

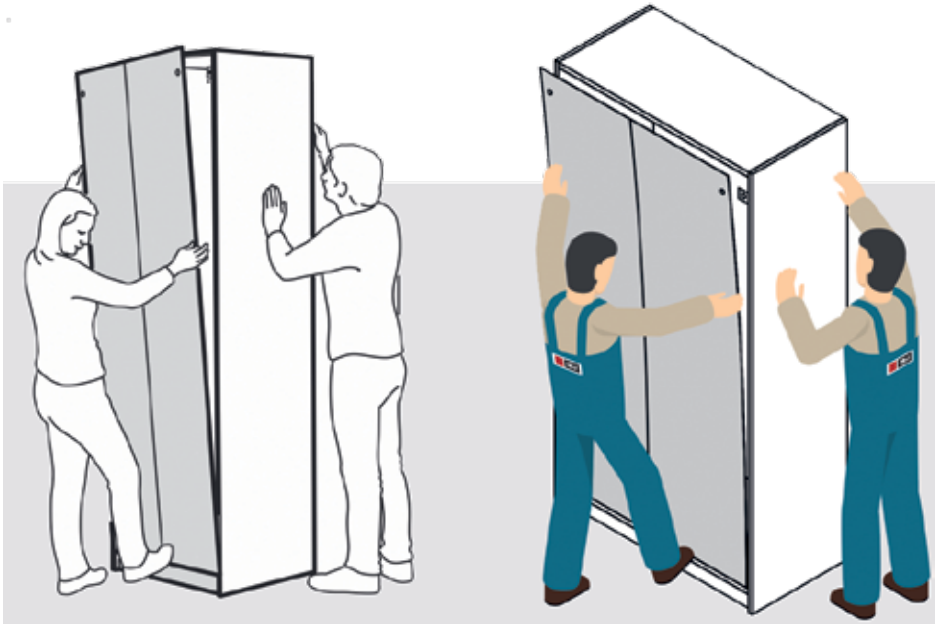

Figure 7: Excerpt from an Ikea assembly instruction and a possible representation in an industrial environment

People in 2D

Considering that people in illustrations are usually represented on a scale between 1:50 and 1:100, many details can be left out without any impact on clarity. This makes 2D work much easier. With optimally prepared vector objects, people in a fixed projection can quickly be placed in the vectors generated from the 3D model. Due to a structure based on the human anatomy with defined rotation points, the adjustment is effortless. However, it is precisely this movability that ensures that an outline representation is not possible. For example, at the joints, the outlines of the thigh and lower leg would protrude into each other. Therefore, a full-surface representation is necessary. In 2D, at least 2 representations are necessary: one from the front and one from the back. For further projections and positions, the human must be created individually. Against the defined background of the application, experience shows that 90 percent of all situations can be described with the person in Figure 6.

With just a few mouse clicks, we can adapt individual body parts to different work situations via the object structure. The appearance is customized centrally via object styles. For example, one mouse click decides whether the people in an entire set of illustrations wear gloves or not. The 2D person is equipped with referenced graphical content. This ensures efficiency through defined reuse and reference.

Application and conclusion

Going back to the example of Ikea and, more specifically, the installation of a back panel in a Pax cabinet, the adaptation of the ready-to-use 2D men to the required situation as shown in Figure 7 took less than five minutes. Men and hands in technical illustrations can be efficiently implemented: with limitations but very efficiently in 2D, and with fewer limitations but a bit more time-consuming in 3D.

ABOUT THE AUTHOR

Marco Jänicke is a mechanical engineer and has worked as a designer in plant engineering. For 20 years, he has been running the engineering office for technical documentation IBJ. With the docuinfotainment portal www.bravecroc.com, he offers informative and entertaining content around technical communication. Furthermore, he is the author of the book "Technical Illustration with Tools from Corel".

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