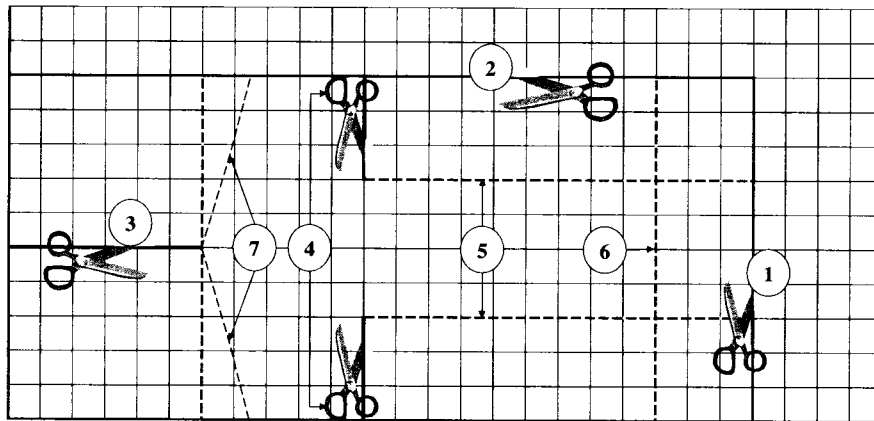


**Table 2.3.** Detailed version of a paper helicopter SOP

<b>Title:</b> Detailed SOP for paper helicopter manufacturing
<b>Scope:</b> For use by college and graduate students
<b>Summary:</b> A detailed method to make a “base-line” paper helicopters is provided.
<b>Training Qualifications:</b> None
<b>Equipment and Supplies:</b> Scissors, metric ruler, A4 paper
<b>Method:</b> The steps below refer to Figure 2.4. <ol style="list-style-type: none"> <li>1. Make cut ① 23 cm. from lower left paper corner.</li> <li>2. Make cut ② 10 cm. from bottom.</li> <li>3. Make cut ③ 5 cm. down from the end of cut 2.</li> <li>4. Make 2 cuts, both labeled ④ in Figure 2.4, 3 centimeters long each.</li> <li>5. Fold both sides of the base inwards along the crease lines labeled ⑤.</li> <li>6. Fold the bottom up along the crease line labeled ⑥.</li> <li>7. Fold wings in opposite directions along crease lines labeled ⑦.</li> </ol>



**Figure 2.4.** Helicopter cut (—) and fold (--) lines (not to scale, grid spacing = 1 cm)

Note that not all information in a blueprint, including specification limits, will necessarily be included in a manufacturing SOP. Still, the goal of the SOP is, in an important sense, to make products that consistently conform to specifications.

The fact that there are multiple possible SOPs for similar purposes is one of the central concepts of this book. The details of the SOPs could be input parameters for a system design problem. For example, the distances 23 centimeter and 5 centimeter in the above paper helicopter example could form input parameters  $x_1$  and  $x_2$  in a system design improvement project. It is also true that there are multiple ways to document what is essentially the same SOP. The example below is intended to offer an alternative SOP to make identical helicopters.

Example 2.6

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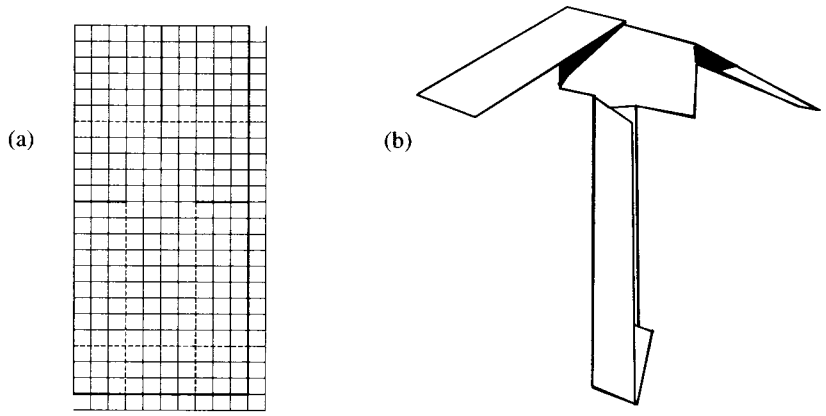
**Example 2.6.2 Concise Paper Helicopter Manufacturing SOP**

**Question:** Provide a more concise SOP for producing paper helicopters.

**Answer:** Table 2.4 below contains a concise SOP for paper helicopter manufacturing.

**Table 2.4.** The concise version of a paper helicopter SOP

<b>Title:</b> Concise SOP for paper helicopter manufacturing
<b>Scope:</b> For use by college and graduate students
<b>Summary:</b> A concise method to make a "base-line" paper helicopters is provided.
<b>Training Qualifications:</b> None
<b>Equipment and Supplies:</b> Scissors, metric ruler, A4 paper
<b>Method:</b> Cut on the solid lines and fold on the dotted lines as shown in Figure 2.5(a) to make a helicopter that looks like Figure 2.5(b).



**Figure 2.5.** (a) Paper with cut and fold lines (grid spacing is 1 cm); (b) desired result

With multiple ways to document the same operations, the question arises: what makes a good SOP? Many criteria can be proposed to evaluate SOPs, including cost of preparation, execution, and subjective level of professionalism. Perhaps the most important criteria in a manufacturing context relate to the performance that a given SOP fosters in the field. In particular, if this SOP is implemented in the company divisions, how desirable are the quality outcomes? Readability, conciseness, and level of detail may affect the outcomes in unexpected ways. The next chapters describe how statistical process control (SPC) charting methods provide thorough ways to quantitatively evaluate the quality associated with manufacturing SOPs.

### 2.6.2 Measurement SOPs

Quite often, SOPs are written to regulate a process for measuring a key output variable (KOV) of interest. For example, a legally relevant SOP might be used by a chemical company to measure the Ph in fluid flows to septic systems. In this book, the term “measurement SOPs” refers to SOPs where the associated output is a number or measurement. This differs from “production SOPs” where the output is a product or service. An example of a measurement SOP is given below. In the next chapters, it is described how gauge R&R methods provide quantitative ways to evaluate the quality of measurement SOPs.

#### Example 2.6.3 Paper Helicopter Measurement SOP

**Question:** Provide an SOP for measuring the quality of paper helicopters.

**Answer:** Table 2.5 describes a measurement SOP for timing paper helicopters.

**Table 2.5.** Paper helicopter measurement SOP

<b>Title:</b> SOP for measuring paper helicopter for student competition
<b>Scope:</b> For use by college and graduate students
<b>Summary:</b> A method is presented to measure the time in air for a student competition.
<b>Training Qualifications:</b> None
<b>Equipment and Supplies:</b> Chalk, chair, stopwatch, meter stick, and two people
<b>Method:</b> <ol style="list-style-type: none"> <li>1. Use meter stick to measure 2.5 meters up a wall and mark spot with chalk.</li> <li>2. Person 1 stands on chair approximately 1 meter from wall.</li> <li>3. Person 1 orients helicopter so that base is down and wings are horizontal.</li> <li>4. Person 2 says “start” and Person 1 drops helicopter and Person 2 starts timer.</li> <li>5. Person 2 stops timer when helicopter hits the ground.</li> <li>6. Steps 2-5 are repeated three times, and average time in seconds is reported.</li> </ol>

### 2.7 References

- Harry, MJ, Schroeder R (1999) Six Sigma, The Breakthrough Management Strategy Revolutionizing The World's Top Corporations. Bantam Doubleday Dell, New York
- Pande PS, Neuman RP, Cavanagh, R (2000) The Six Sigma Way: How GE, Motorola, and Other Top Companies are Honing Their Performance. McGraw-Hill, New York