# Plackett – Burnam experimental design

- This is also a rapid method for factor ranking but it requires specific organization.
- In general, these are designs with fixed number of necessary experiments depending on the number of input factors.
- They are carried out with two levels of variation of the input factors as in many other factorial designs.
- The first and the last row of the design are given with a priori fixed structure (the rows are, again, the conditions for the real experiments)
- Dummies are also introduced.
- The final goal is factor ranking.

# The most simple Plackett-Burman design

**Plackett–Burman 8-Run Matrix**

| Treatment Combinations | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| 1 | + | - | - | + | - | + | + |
| 2 | + | + | - | - | + | - | + |
| 3 | + | + | + | - | - | + | - |
| 4 | - | + | + | + | - | - | + |
| 5 | + | - | + | + | + | - | - |
| 6 | - | + | - | + | + | + | - |
| 7 | - | - | + | - | + | + | + |
| 8 | - | - | - | - | - | - | - |

# Some explanations

- The first and the last rows are fixed.
- Each new line is formed by moving the last element of the previous row as the first element in the following row (this is simple row by row rotation except for the last row).
- In this design there are 7 factors to be ranked by 8 experiments.
- Some of the factors could be dummies.
- Each column consists of equal number of experiments both on “+” and “-” level of the inputs.

# Next possible Plackett – Burman design or 11 factors for 12 experiments

## Resolution III Designs
### – Plackett-Burman Designs

Shift down one row!

■ TABLE 8.24
Plackett–Burman Design for $N = 12, k = 11$

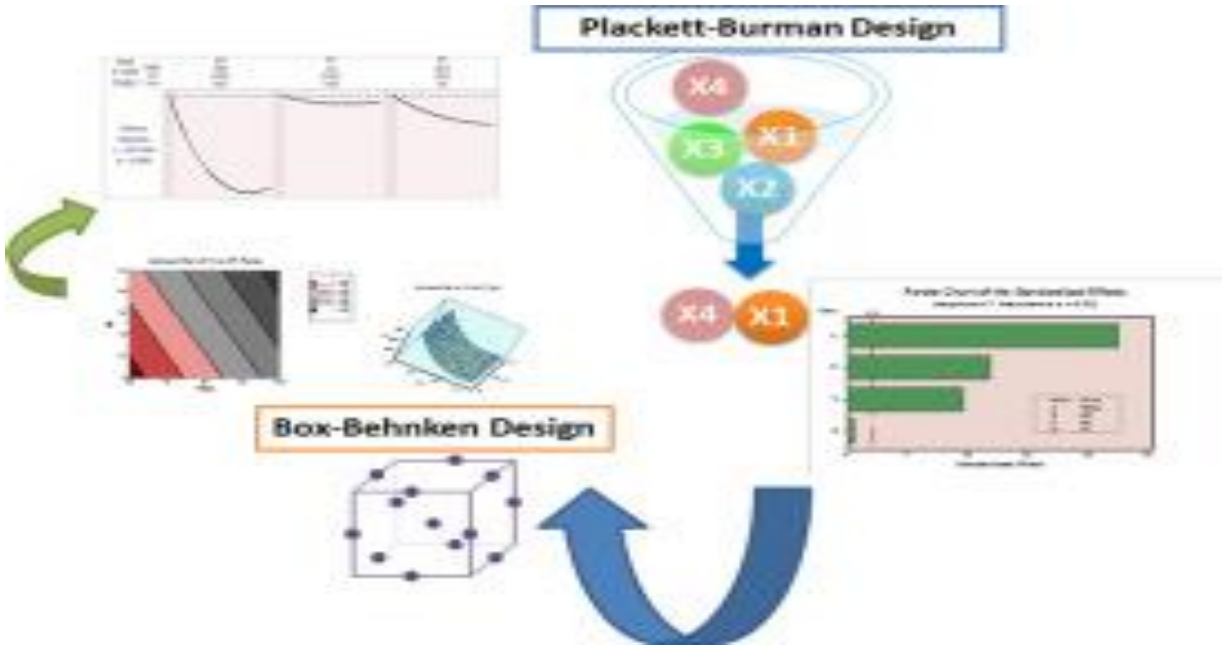
| Run | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | + | − | + | − | − | − | + | + | + | − | + |
| 2 | + | + | − | + | − | − | − | + | + | + | − |
| 3 | − | + | + | − | + | − | − | − | + | + | + |
| 4 | + | − | + | + | − | + | − | − | − | + | + |
| 5 | + | + | − | + | + | − | + | − | − | − | + |
| 6 | + | + | + | − | + | + | − | + | − | − | − |
| 7 | − | + | + | + | − | + | + | − | + | − | − |
| 8 | − | − | + | + | + | − | + | + | − | + | − |
| 9 | − | − | − | + | + | + | − | + | + | − | + |
| 10 | + | − | − | − | + | + | + | − | + | + | − |
| 11 | − | + | − | − | − | + | + | + | − | + | + |
| 12 | − | − | − | − | − | − | − | − | − | − | − |

Add "-" sign

# Why Plackett – Burman ?

- Very often the Plackett – Burman designs are applied as a preliminary step for other experimental designs since they make it possible to select a reasonable number of significant input factors out of a community of large number of factors.
- The scientist should be aware of the point that these designs do not take into account interactions and, therefore, it is good to know in advance that there are no factor interactions or they are negligible with respect to the experimental error (dummy effect).

# How to proceed in experimental design



# More complex designs

- In the real practically oriented cases quite comlpex relationships and interactions are possible. For instance, real cases require non linear models to describe their behavior.
- Then the models the scientist need should look like with well expressed nonlinearity. Obviously, the assessment of the regression weights in this case will need more complicated designs.

$$Y = a_0 + \sum_{i=1}^{n} a_i\, x_i + \sum_{i=1}^{n} a_{ii}\, x_{ii}^2 + \sum_{i,j=1}^{n} a_i\, a_j x_i x_j$$