

What are data, information, and knowledge?

Last Updated November 26, 2018

Data, information, and knowledge are often used interchangeably. However, these terms represent different stages of value creation from data to decision-making.

Data are the raw alphanumeric values obtained through different acquisition methods. Data in their simplest form consist of **raw alphanumeric values**.

Information is created when data are processed, organized, or structured to provide context and meaning. Information is essentially **processed data**.

Knowledge is what we know. Knowledge is unique to each individual and is the accumulation of past experience and insight that shapes the lens by which we interpret, and assign meaning to, information. For knowledge to result in action, an individual must have the authority and capacity to make and implement a decision. Knowledge (and authority) are needed to produce **actionable information** that can lead to impact.

The flow and characteristics of these terms are illustrated in Figure 1 and Table 1. Table 2 provides examples of data, information, and knowledge for water data.

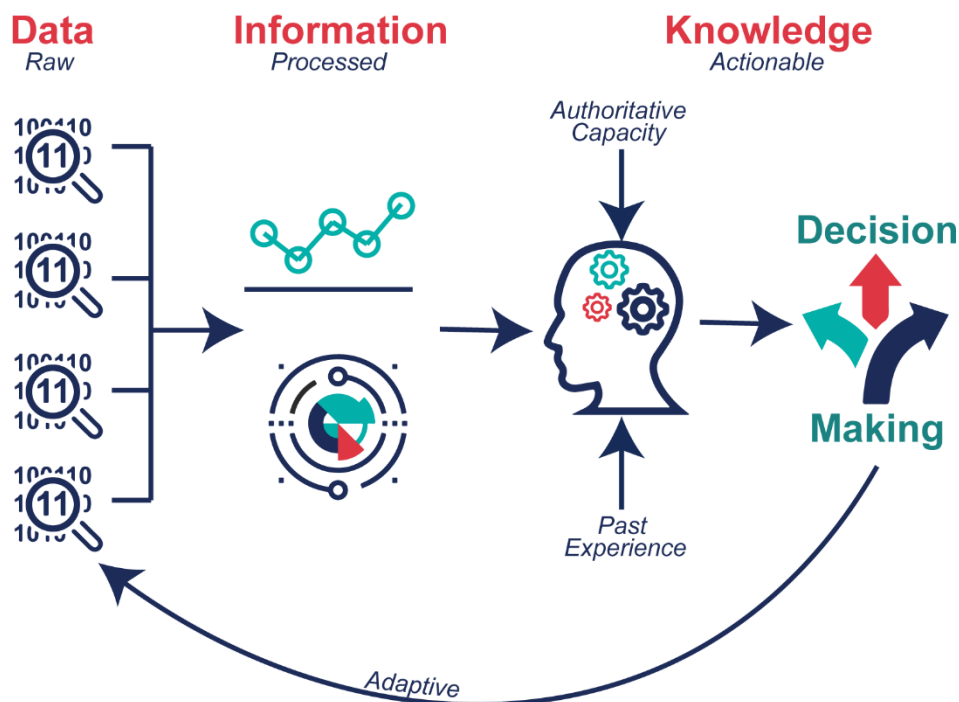


Figure 1: The flow from data to information to knowledge.

The flow from data to information and knowledge is not uni-directional. The knowledge gained may reveal redundancies or gaps in the data collected. As a result, an actionable insight may be to change the data collected, or how those data are converted into information, to better meet user needs.

Table 1: Characteristics of data, information, and knowledge (adopted from de Vries 2018).

Data	Information	Knowledge
Is objective	Should be objective	Is subjective
Has no meaning	Has a meaning	Has meaning for a specific purpose
Is unprocessed	Is processed	Is processed and understood
Is quantifiable, there can be data overload	Is quantifiable, there can be information overload	Is not quantifiable, there is no knowledge overload

Table 2: Examples of transforming water data to information to knowledge that leads to action.

Data	Information	Knowledge to Action
Stream gage height	Convert gage height to stream-flow estimates to provide summary stats for last 10 years	Restrict withdrawals because streamflow is below 7Q10
Amount of precipitation in rain gage	Assess whether annual precipitation is increasing, decreasing, or staying the same	Prioritize investing in floodplain mapping given increases in precipitation over last 20 years
Amount of lead in water samples	Combine lead level, customer, and drinking water standards data to locate violations	Alert identified customers that lead levels exceed safe drinking water standards
Volume of treated water	Correlate volume of treated water with number of low flush toilets installed over time	Continue investing in the low flush toilet rebate program given large water savings

For more information:

de Vries, R.A. 2018. [The importance of user analysis before the technical design of an instrument, which presents information to users from a different discipline.](#)

Stander, J.B. 2015. [The modern asset: big data and information valuation.](#)