Estimation of car-density in city districts
-deploying automated extraction algorithms and satellite imagery-

A Munich based market research team approached the Tama Group with following question:" After 'Search' the marketing focus was 'Social', and now this focus moves on to 'Location'. Those retailers being able to adapt their marketing strategies to the current location of their customer will have considerable advantages in the market. This is especially true for stationary retailers with consumer good portfolios. We would like to understand if up to date and very high resolution satellite imagery could provide a clear statement in which city district and in in which streets many cars are moving or parked. The variation of this pattern over time is our second point of interest. Advertising companies as well as mobile fresh-food services like food trucks are interested in high car densities, commuters are a target audience looking for low car density areas."

Caused by new apps for parking lot identification, advanced navigation systems as well as 'shared car services', the pattern of car density is steadily changing. Can you supply the ability to gather such information in an automated way and deliver that as push service?" Since this task needs very high resolution satellite image data, the Tama Group contacted European Space Imaging (EUSI) for sample data.

Figure 1 shows the pre-processed image data which convinced us: a city district in the west of Munich [EUSI, Tama Group]
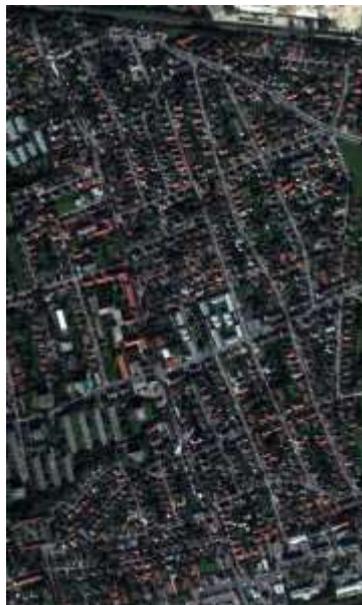
Figure 2: Auxiliary street data (yellow) is fused with the image data [EUSI, Tama Group]

In a first step, the satellite image data is fused automatically with an existing street map. Hence the gathering area 'street' is created (Figure 2). Subsequently, an automated delineation of the vegetation is performed in order to avoid any misclassification caused by vegetation (Figure 3, dark green). The third step is the delineation and detection of single car objects within the class 'street' (Figure 4).

Figure 3: Based on the NDVI, a vegetation mask is applied [Tama Group Ruleware]

Figure 4: The single car objects are delineated and detected within the class 'street' [Tama Group Ruleware].

The density, i.e. the number of cars per unit, is finally computed using spatial units, in this case a grid. Figure 6 shows the density in the grid with a color code. With this, a clear and comprehensible statement is provided about the density pattern in the respective city district. Based on high degrees of automation and accuracy achieved, the Tama Group was able to respond positively to the initial question.

Figure 5: Subset of Figure 4. The single car objects are clearly visible [Tama Group Ruleware].

Figure 6: Using spatial units (here: grid) to display the density gives a comprehensible and clear statement about the pattern [Tama Group Ruleware].

Satellite images are almost ubiquitous and provide a very broad range of information. Thus, not only commercial or administrative but also humanitarian questions can be answered.

We cover a broad range of applications including emergency management, town planning as well as market investigations as shown above.

The currentness of satellite imagery creates highly valuable information. In combination with other data sources for example from laser scanners, drones or existing GIS data sets, we can create value-added information. Structured in form of solution development project, the Tama Group can provide such sources of current information.

Application overview: "Estimation of car-density in city districts"

Data sources	Satellite image(s), Street data (vector data set)
Preprocessing	Selection of the respective city district
Software	eCognition Developer [eCognition Architect]
Ruleware	4-stepped approach: - Fusion of image data and street data (automated) - Vegetation mask (automated) - Detection of cars (automated) - Generation of density map (automated)
Result	Export format: - Image data (JPEG/TIF/PNG) - Map with geo-coordinates - Tabular information

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Tama Group specializes in automated information extraction, especially in object-based image analysis with eCognition.
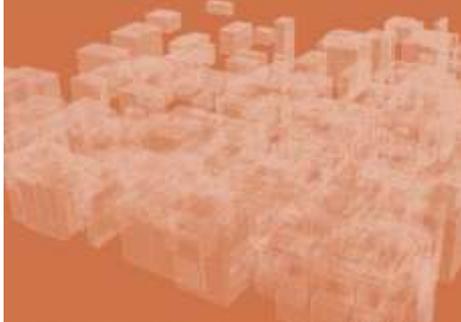
We analyze images from various sensors and continue to refine our methods of automating information extraction. In doing so we combine machine learning, deep learning and expert knowledge.

With our **forest portal**, we are able to offer an image-based digital twin of his forest to practically every forestry company. This allows us to provide important information about the managed forest area in a clear manner.

Our **information factories** offer solutions for specific questions in various industrial areas such as agriculture, construction, energy, transport, environmental protection and materials science.

Distribution of Trimble eCognition: We offer an extensive sales, support and training portfolio, including our 4D maintenance package.