Given an augmented tLDBA $\bar{B}_\varphi = (\bar{X}, \bar{x}_{init}, \bar{\Sigma}, \bar{\delta}, \bar{\mathcal{F}})$ and a DES D, a tuple $D \otimes \bar{B}_\varphi = D^\otimes = (S^\otimes, E^\otimes, s^\otimes_{init}, P^\otimes_T, P^\otimes_E, \delta^\otimes, \mathcal{F}^\otimes)$ is a product DES, where $S^\otimes = S \times \bar{X}$ is the finite set of states and we represent s and $\bar{x}$ corresponding with $s^\otimes = (s, \bar{x}) \in S^\otimes$ as and , respectively; $E^\otimes = E \cup \{\varepsilon_{\bar{x}'}; \exists \bar{x}' s.t. (\bar{x}, \varepsilon, \bar{x}') \in \bar{\delta}\}$ is the finite set of events, where $\varepsilon_{\bar{x}'}$ is the event that represents an probability defined as $\mathrm{P}_T^{\otimes}(s^{\otimes\prime}|s^{\otimes},e) = \begin{cases} P_T(s'|s,e) & if\ (\bar{x}, L((s,e,s')), \bar{x}') \in \bar{\bar{\delta}}, e \in \mathcal{E}(s) \\ 1 & if\ s = s', (\bar{x}, \varepsilon, \bar{x}') \in \delta, e = \varepsilon_{\bar{x}'} \\ 0 & otherwise, \end{cases}$ where $s^{\otimes} = (s,(x,v))$ and $s^{\otimes\prime} = (s',(x',v'))$. $P_E^{\otimes} : E^{\otimes} \times S^{\otimes} \times 2^{E^{\otimes}} \rightarrow [0,1]$ is the probability of the occurrence of the event defined as $P_E^{\otimes}(e|s^{\otimes},\pi) = P_E(e|s,\pi)$, $\delta^{\otimes} = \{(s^{\otimes},e,s^{\otimes\prime}) \in S^{\otimes} \times E^{\otimes} \times S^{\otimes}; P_T^{\otimes}(s^{\otimes\prime}|s^{\otimes},e) > 0\}$ is the set of transitions, and $\mathcal{F}^{\otimes} = \{\bar{F}_1^{\otimes}, \ldots, \bar{F}_n^{\otimes}\}$ is the acceptance condition, where $\bar{F}_i^{\otimes} = \{((s,\bar{x}),e,(s',\bar{x}')) \in \delta^{\otimes}\ ;\ (\bar{x}, L(s,e,s'), \bar{x}') \in \bar{F}_i\}$ for each $i \in \{1, \ldots, n\}$.

The two re-